MODEL M100F50

FLOTROL
RECTIFIER

SPEC NO. 5451-001 SERIAL NO. _____

THIS FLOTROL RECTIFIER IS ADJUSTED

TO _____ VOLTS. _____ VOLTS PER CELL

FOR A _____ CELL BATTERY. INPUT _____ VAC

OPTIONAL WIRING OR APPARATUS FURNISHED:

A, B, E, G, H, J, K, M, N, Q, R, S, T, V, W, X, Y, Z,

OTHER _____

1. SPECIFICATION

1.4 STANDARD FEATURES (CONT'D)

1.4.6 Mounting: Angles provided for 23 inch relay rack mounting. Additional mountings are available - see Accessories, paragraph 1.6.5.

1.4.7 Alarms
- (A) Operation of the A-C Control fuse causes the rectifier to turn off, one alarm circuit to close, one alarm circuit to open and a front panel RECT FAIL lamp to light.
- (B) If the A-C input current fails or the rectifier is manually turned off, a circuit is furnished which causes one alarm circuit to close, one alarm circuit to open and a front panel RECT FAIL lamp to light.
- (C) Operation of the High Voltage Shut Down circuit or either of two accessory alarm assemblies (refer to paragraph 1.6.4) causes a RECT FAIL lamp to light.
- (D) Operation of the D-C Control, Paralleling, Filter Capacitor or Output Fuse causes a front panel FUSE ALM lamp to light.

1.4.8 Load Sharing Circuit: A fuse protected circuit is provided to obtain proportional division of load with other similarly equipped FLOTROL Rectifiers.

1.4.9 Transformer Tap Adjustment: Transformer taps are furnished for 23, 24, 25 or 26 cells of battery.

1.5 ENVIRONMENTAL RATINGS

1.5.1 Operating Ambient Temperature Range: -20°C to +50°C (-4°F to +122°F)

1.5.2 Storage Temperature Range: -40°C to +85°C (-40°F to +185°F)

1.5.3 Heat Dissipation: 1880 BTU/HR

1.5.4 Ventilation Requirements: In mounted position, the unit should be located so that ventilating openings are not blocked and air entering cabinet does not exceed +50°C (+122°F).

1.6 ACCESSORIES AVAILABLE BUT NOT INCLUDED WITH THE STANDARD MODEL

1.6.1 Remote Control (shown on schematic diagram as "Y" Option) operates from 48 volt D-C: (1) part no. 4846-

1.6.2 Equalize Charge Timer (shown on schematic diagram as "X" Option), up to 24 hour: (1) part no. 2544-452

1.6.3 Battery Eliminator Filter, externally mounted (shown on schematic diagram as "K" Option) reduces output noise to less than 32 dbrn, C-message, without battery: (1) part no. 4826-035

1.6.4 Alarm Assemblies - Choice of either of the following assemblies which will cause two alarm circuits to close, two alarm circuits to open and a front panel RECT FAIL lamp to light.
- (A) Charge Failure Alarm (Shown on the schematic diagram as "S" Option. Refer to paragraph 4.9.): (1) part no. 4846-092
- (B) High and Low Voltage Alarm (Shown on the schematic diagram as "N" Option. Refer to paragraph 4.9.) (1) part no. 4863-114

1.6.5 Mountings
- (A) Mounting angle for 30 inch Unistrut relay rack (requires 36-3/4 inch rack space): (2) part no. 3628-41
- (B) Floor Stand (replaces relay rack angles): (1) part no. 3727-706

1.7 MISCELLANEOUS

1.7.1 Schematic Diagrams
- (A) FLOTROL Rectifier: SD1738-05
- (B) Control Unit: SD1785-01

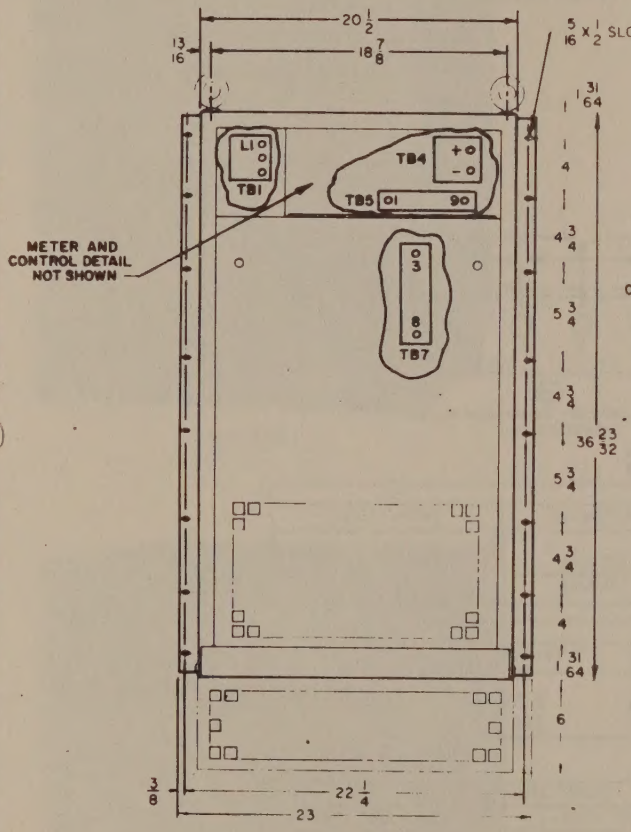
1.7.2 Wiring Diagrams
- (A) FLOTROL Rectifier: T1738-05
- (B) Control Unit: T1785-01

1.7.3 Instructions: Form 1884

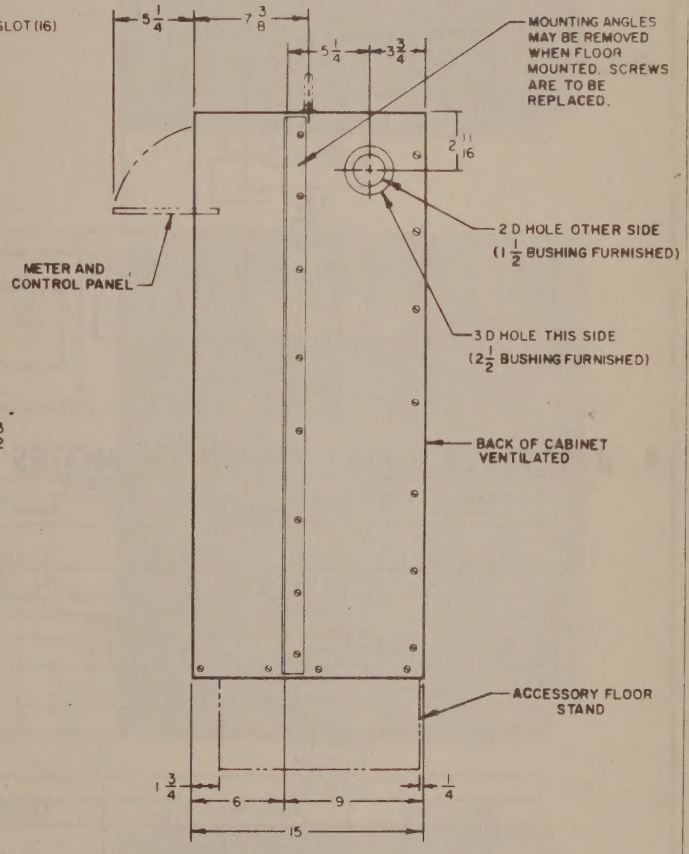
1.7.4 Performance Curves
- (A) Input Amps/Output Amps:
- (B) Output Volts/Output Amps:
- (C) Power Factor/Output Amps:
- (D) Efficiency/Output Amps:

1.7.5 Photographs: 6951, 6952, 6953 and 6858 through 6864, inclusive

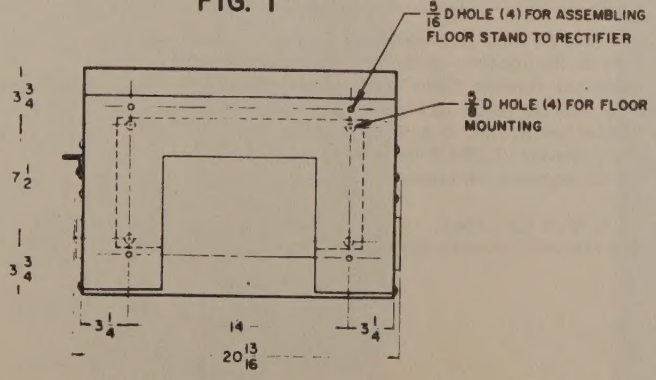
2. DIMENSIONS



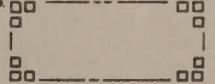
FRONT VIEW
FIG. 1



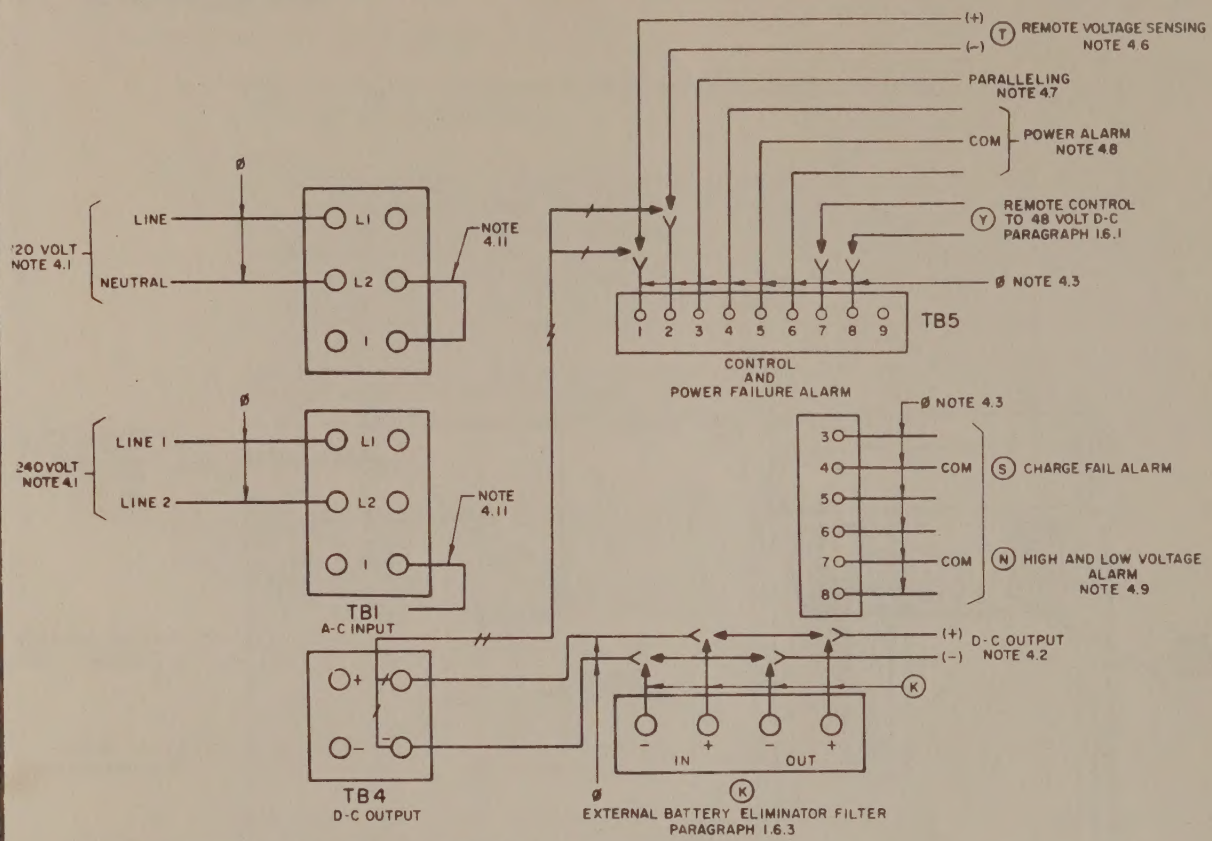
SIDE VIEW
FIG. 2



BOTTOM VIEW
FIG. 3

NOTES:
1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. WEIGHT
   (A) SHIPPING: 494 LBS
   (B) NET: 470 LBS
3. FINISH: TWO TONE GREY
4. 
INDICATES VENTILATING GRILLE

3. INSTALLER'S CONNECTIONS - READ THE INSTRUCTION BOOK FOR INSTALLATION DETAILS.



4. INSTALLER'S INFORMATION NOTES

4.1

A-C INPUT			
Voltage	Recm Wire Size	Recm Fusing	Term. Cap.
120	2 Ga.	(1) 100 Amp	14 Ga. - 1/0
240	6 Ga.	(2) 50 Amp	

4.2

D-C OUTPUT		
Loop Length*-Ft	Recm Wire Size	Term. Cap.
50	1/0	6 Ga. to 250 MCM
100	1/0	

* - Note 4.4

4.3

GROUND		ALARM AND CONTROL	
Term. Cap	Recm Wire Size	Term. Cap.	Recm Wire Size
		18-4 Ga.	18 Ga.

4.4 D-C output wire size sufficient to restrict voltage drop to 1 volt or less at rated full load output current for the loop lengths shown. The loop length is the sum of the lengths of the positive and negative leads.

4.5 Wire sizes meet those recommended in National Electric Code Table 310-12 for 60°C conductor temperature.

4.6 Provision is made to extend remote voltage sensing leads to battery or power board terminals, "T" Option. Unless otherwise specified, leads are factory-connected to D-C Output terminals.

4.7 Connect this lead to paralleling terminal on similar FLOTROL Rectifiers.

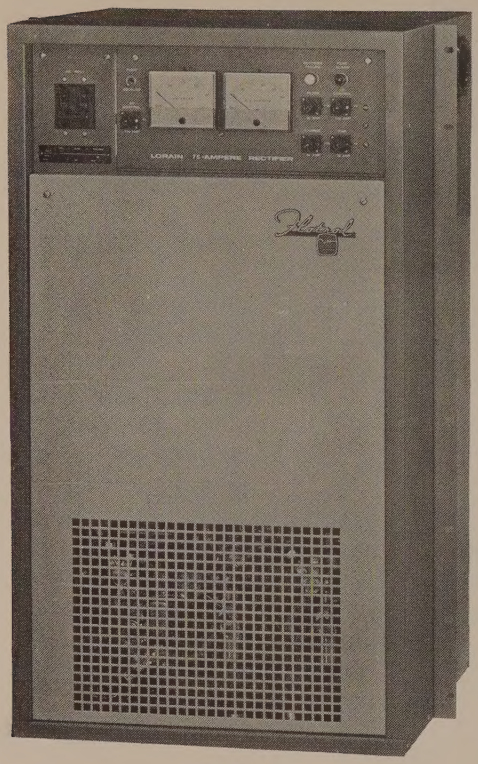
4.8 Power failure is indicated by a closed circuit between terminals 4 to 5 and an open circuit between terminals 5 to 6 of terminal block TB5.

4.9 When "N" or "S" Option (see paragraph 1.6.4) is furnished, an alarm condition is indicated by closed circuits between terminals 4 to 5 and 7 to 8 and open circuits between terminals 3 to 4 and 6 to 7 of terminal block TB7.

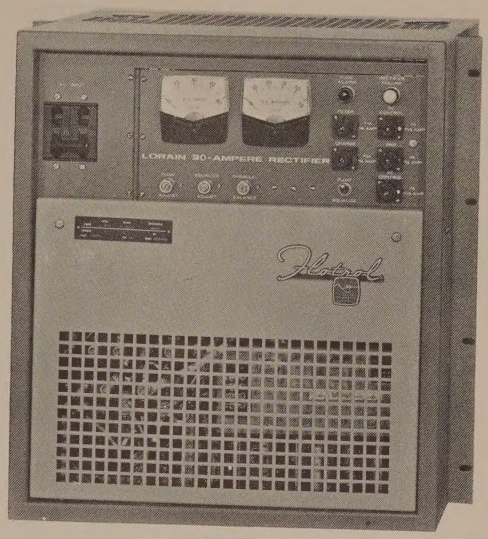
4.10 ϕ indicates leads run by installer.

4.11 Copper bus bar

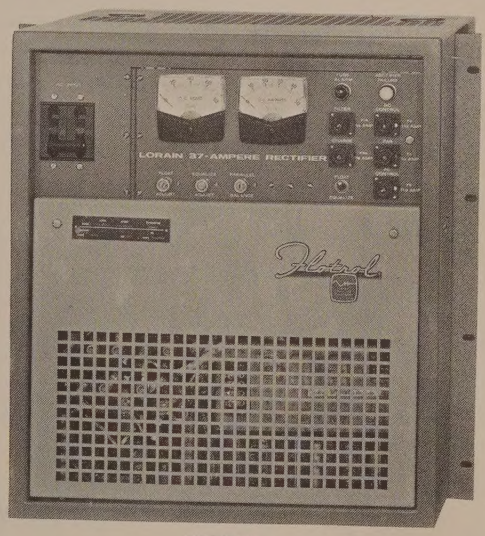
INSTRUCTIONS
LORAIN LARGE SINGLE PHASE
"M" SERIES FLOTROL RECTIFIERS



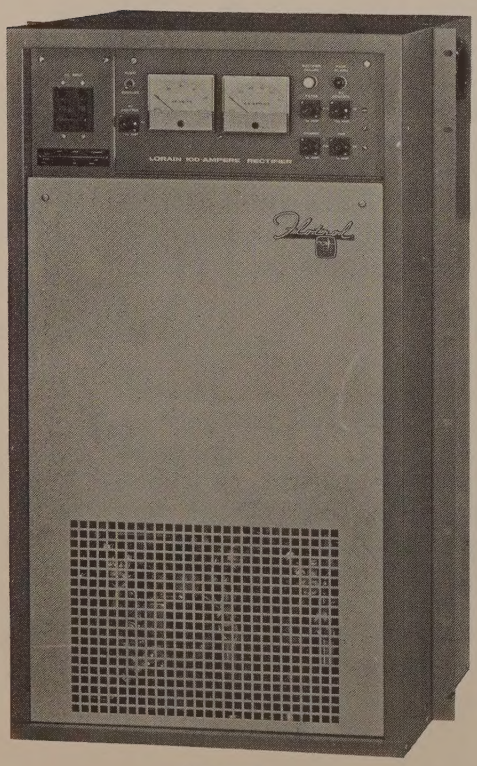
M75F50



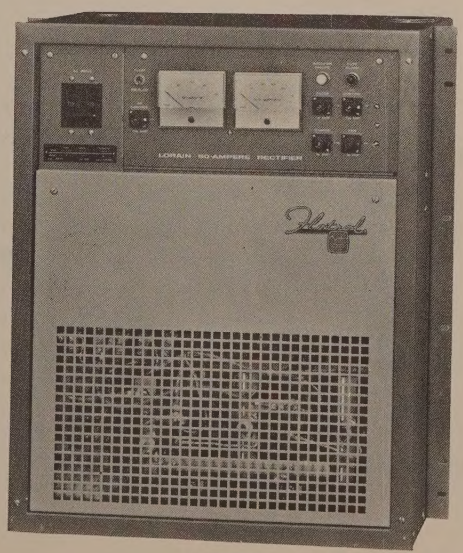
M30F50



M37F50



M100F50



M50F50

Form 1884

GENERAL INSTRUCTIONS FOR LARGE SINGLE PHASE "M" SERIES FLOTROL RECTIFIERS

TABLE OF CONTENTS

		Page
1.	RATINGS	1
2.	DESCRIPTION	
	a. General	1
	b. Accessories	1
3.	INSTALLATION	
	a. Location	2
	b. Mounting	2
	c. Preliminary Adjustment	2
	d. Electrical Lead Entrance Options	3
	e. Output Lead Requirements	3
	f. Electrical Connections	3
	g. Control Connections	7
	h. Installation Check	8
4.	ADJUSTMENTS	
	a. General	9
	b. Input Voltage Range	9
	c. Output Voltage Range	9
	d. Battery Float Voltage	9
	e. Charge-equalize Voltage	10
	f. Output Current Limit	10
	g. Rectifier Paralleling Balance	10
	h. Equalize Charge Timer	10
	i. High Voltage Shutdown Circuit Adjustment	10
	j. Accessory High-low Voltage Alarm Assembly Adjustment	12
	k. Anti-hunt Adjustment	13
	l. Manufacturer Adjustments	13
5.	OPERATION	
	a. General	13
	b. Starting and Stopping	13
	c. Metering	14
	d. Recharge, Equalize Charge	14
	e. Equalize Charge Timer Accessory	14
	f. Manual Output Voltage Regulation Accessory	14
	g. High-Voltage Shutdown	15
	h. End Cell Charging	15
	i. Alarm Indications	16
	j. Fuses, Circuit Breakers	16
	k. Component Boards	17

Page

6. CIRCUIT DESCRIPTION, GENERAL

a. Power Circuit 17
b. Voltage Regulator Circuit 19
c. Pulse Amplifier 19
d. High Voltage Shutdown Circuit 19
e. Current Limiting and Load Sharing Circuit 19
f. Self-starting Circuit 20
g. Disconnect Relay 20
h. Accessory Alarm Circuits 20

1. RATINGS

MODEL	1φ INPUT			OUTPUT			
	VOLTAGE	CURRENT (AMPERES)	FREQUENCY (CPS)	VOLTAGE		CELLS	CURRENT (AMPERES)
				NOMINAL	FLOAT ADJ RANGE *		
M30F50	115/230	24/12	50 OR 60	50	48.3-57	23-26	30
M37F50	115/230	28.5/14.6	50 OR 60	50	48.3-57	23-26	37
M50F50	115/230	36/18	50 OR 60	50	48.3-57	23-26	50
M75F50	115/230	55/27.5	50 OR 60	50	48.3-57	23-26	75
M100F50	115/230	80/40	50 OR 60	50	48.3-57	23-26	100

* Higher voltages may be obtained when equalizing battery cells or when end cell charging. Under these conditions, regulation is guaranteed up to 58.5 volts.

2. DESCRIPTION

a. General

This FLOTROL Rectifier changes standard a-c power to direct current of suitable voltage to maintain a 23, 24, 25 or 26 cell battery in fully charged condition.

An input voltage range adjustment adapts this FLOTROL Rectifier to 94 to 114 volt, 105 to 129 volt, 187 to 229 or 211 to 257 volt a-c input. Thus, it can operate from either nominal 115 volt or nominal 230 volt a-c power, at either prevailingly-low or prevailingly-high a-c power voltage.

This unit will maintain the steady state d-c output voltage within ± 1/2% for any load from no load to full load despite ± 10% variation of a-c power voltage and input frequency variation between 47-63 cycles per second.

Since charging voltage is constant, FLOTROL Rectifier output current will remain equal to d-c load current so long as load current does not exceed its output rating. This mode of operation is known as float charging. Since, in normal operation, the battery is not required to furnish load current, it remains in fully charged condition. In this way, battery life is greatly prolonged.

When a-c power failure causes battery discharge, or in event of d-c overload, an output current limiter prevents increase of FLOTROL Rectifier output current to an excessive value.

If higher d-c voltage is required to recharge battery cells after battery discharge, or to equalize charge of all battery cells, a switch can be thrown to obtain higher recharge or equalize charge voltage. This voltage is also adjustable, separately and independently of battery float voltage described above.

This FLOTROL Rectifier has a circuit which monitors output voltage continuously, and shuts off d-c output current and extends an alarm if output voltage should increase to a preset value.

When this Rectifier is used as a battery charger, a-c input or d-c output failure will cause an indicator lamp to light; if this FLOTROL Rectifier is used as a battery eliminator, this indicator lamp will light in event of a failure only if another FLOTROL Rectifier is operating in parallel.

b. Accessories

Special accessories are factory-installed when specified, and are also available for user installation:

(1) Battery Eliminator Filtering Accessory can be used if it is desired to operate this Rectifier as a battery eliminator.

NOTE: This Battery Eliminator Filtering Accessory for Model M100F50 FLOTROL Rectifier must be mounted externally.

(2) A Remote Control Relay Accessory allows this FLOTROL Rectifier to be turned on or off from a remote location.

(3) When higher equalize charge voltage is supplied, an Equalize Charge Timer will automatically restore usual float operation after a preset interval, up to 24 hours.

(4) When charging new batteries or troubleshooting the FLOTROL Rectifier, it might be desirable to regulate the output voltage of the FLOTROL Rectifier manually. A Manual Output Voltage Regulation Accessory will permit the output voltage of the FLOTROL Rectifier to be adjusted to the correct value for one given condition of a-c input voltage and output current. When troubleshooting, the use of this accessory enables the operator of the FLOTROL Rectifier to remove the plug-in circuit cards in the FLOTROL Rectifier for individual testing without taking the FLOTROL Rectifier out of service.

(5) Either of the following alarm accessories can be provided to light lamp RECT FAIL and extend an external alarm:

(a) A Charge Failure Alarm Relay Assembly can be connected to give an alarm in event of d-c current failure.

(b) A High-Low Voltage Alarm Relay Assembly can be connected to give an alarm in event that output voltage goes above or below preset values.

(6) Floor mounting feet are available for use with these models. The mounting feet replace the standard relay rack mounting angles and are available at no extra cost if specified on the original order.

3. INSTALLATION

a. Location

This FLOTROL Rectifier operates best in a well-ventilated area which has an ambient temperature range between -4°F to +122°F. It should also be located so as to limit length of, hence limit voltage drop in, its d-c output leads.

b. Mounting

This Rectifier can either be rack or wall mounted. Refer to the table below for the dimensions and weight of a particular model.

MODEL	HEIGHT	RACK WIDTH	DEPTH	WEIGHT (LBS)	
				SHIP	NET
M30F50	19 7/32"	*19" OR 23"	12"	200	192
M37F50	19 7/32"	*19" OR 23"	12"	270	262
M50F50	26 1/8"	23"	15"	319	265
M75F50	36 23/32"	23"	15"	418	392
M100F50	36 23/32"	23"	15"	496	470

*Universal brackets are provided for either 19" or 23" relay rack or wall mounting.

**Refer to the Overall Drawing in this instruction manual for relay rack mounting bracket attachment details.

CAUTION: In mounted position, a minimum space of 6" must be provided between the front or rear of the unit and adjacent equipment. This is essential for proper cooling during operation.

c. Preliminary Adjustment

Check setting of input voltage range adjustment and reset if necessary. Refer to INPUT VOLTAGE RANGE adjustment procedure in Section 4 b.

3. d. Electrical Lead Entrance Options

Insulating bushings, at upper rear of each side of this FLOTROL Rectifier, furnish electrical lead entrance. Each bushing can be replaced by a standard conduit fitting. Model M30F50, M37F50, and M50F50 FLOTROL Rectifiers have hole plugs of similar size located at either side of cabinet top; if alternate lead entrance is desired, plugs and bushings can be interchanged.

e. Output Lead Requirements

Output terminal block wire capacity is indicated on the Power Data Sheet or on the Wiring Diagram.

To assure correct d-c voltage regulation at battery or power board, voltage drop in FLOTROL Rectifier output leads should be minimized. Recommended output wire size and output terminal block wire capacity as indicated on the Wiring Diagram or Power Data Sheet will limit this voltage drop to 1 volt at full-load output current rating of FLOTROL Rectifier so long as output loop length does not exceed maximum specified for each wire size. These units are designed for a lead drop of up to 1 volt if sensing leads are connected directly to the battery. An additional 1 volt drop can be tolerated if the battery voltage does not exceed 56 volts or the a-c input voltage does not decrease more than 8% from its normal value.

f. Electrical Connections

(1) General

To gain access to installer connection terminals, release two screw-type fasteners below meter panel, lift front cover upward to withdraw two retaining studs at bottom of cover from corresponding slots of cabinet, remove cover from cabinet, then release the screw-type fastener(s) at top or side of meter panel and pivot panel outward on its hinge. Refer to applicable picture of unit in this instruction book.

As viewed from front of FLOTROL Rectifier, d-c output lead entrance is by means of an insulator bushing at upper rear of right side of cabinet. A-c input lead entrance is by means of a similar bushing at upper rear of left side of cabinet.

(2) Power Connections

CAUTION: Before making electrical connections, a-c input circuit breakers should be in the OFF position, except when Model M30F50 or Model M37F50 FLOTROL Rectifier equipped as a battery eliminator is used to charge batteries. When used in this application, the FLOTROL Rectifier must be turned on before the battery is connected at the rectifier output. This prevents the instantaneous charging current of the battery eliminator capacitor bank from opening the rectifier output fuse.

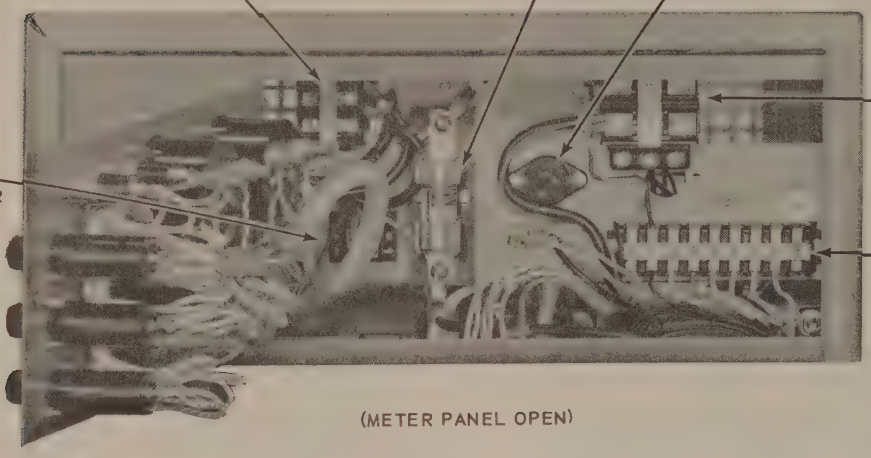
(a) Bring d-c output leads through output bushing and connect at OUTPUT terminal block as indicated by polarity markings.

CAUTION: There will be a current surge and an arc when the charger is connected to the battery. This is caused by the charging of the filter capacitors.

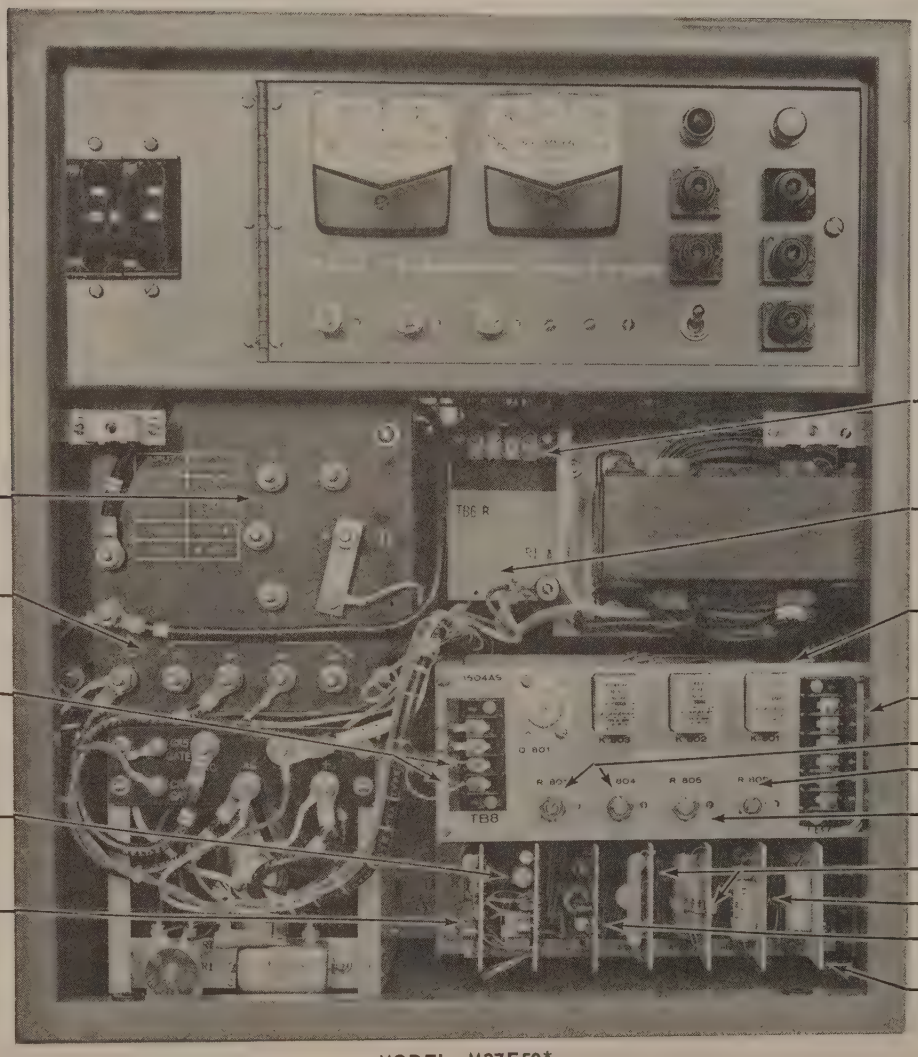
(b) For nominal 115 volt a-c input, it will be necessary to connect the furnished busbar jumper between terminal "L2" and terminal No. 1 on terminal block TB1. For nominal 230 volt a-c input, the busbar jumper must not be used.

NOTE: Unless otherwise specified, these FLOTROL Rectifiers are shipped with one side of the busbar jumper connected to TB1 terminal 1.

(c) Bring single-phase a-c power leads through input bushing and connect to input terminal block TB1. Recommended size of input leads and a-c branch circuit fusing are given on the Wiring

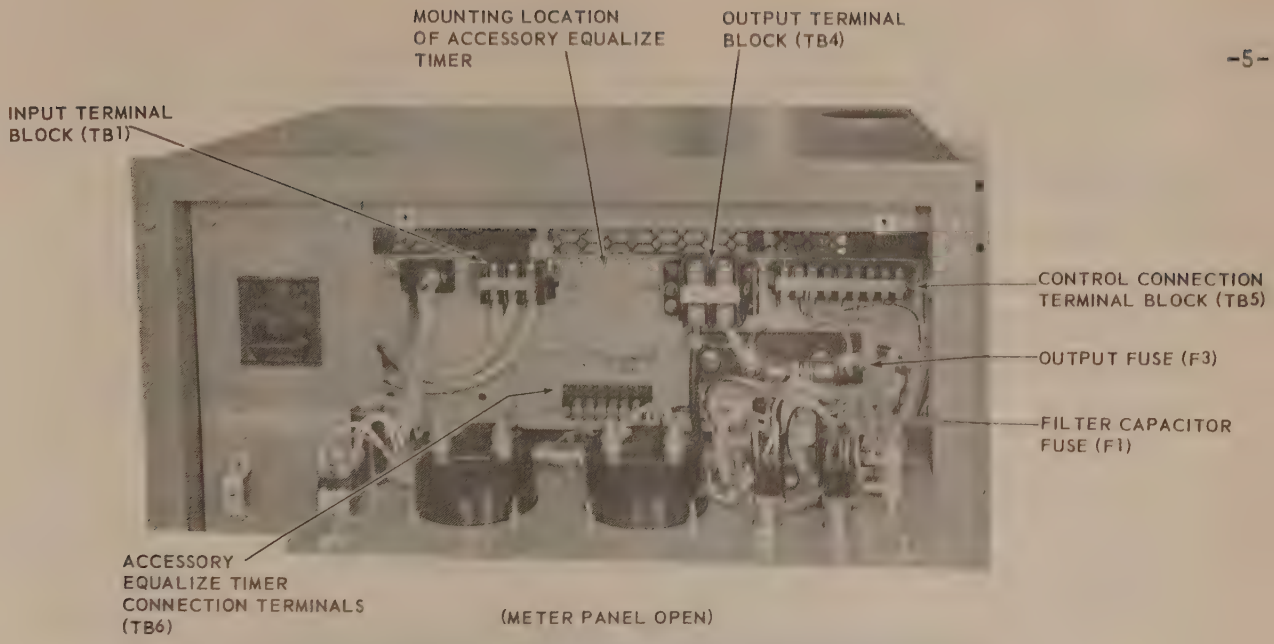

INPUT TERMINAL BLOCK (TB1)
OUTPUT FUSE (F3)
FILTER CAPACITOR FUSE (F1)
OUTPUT TERMINAL BLOCK (TB4)
ACCESSORY EQUALIZE TIMER JUMPER (TB6A)
CONTROL CONNECTION TERMINAL BLOCK (TB5)

(METER PANEL OPEN)

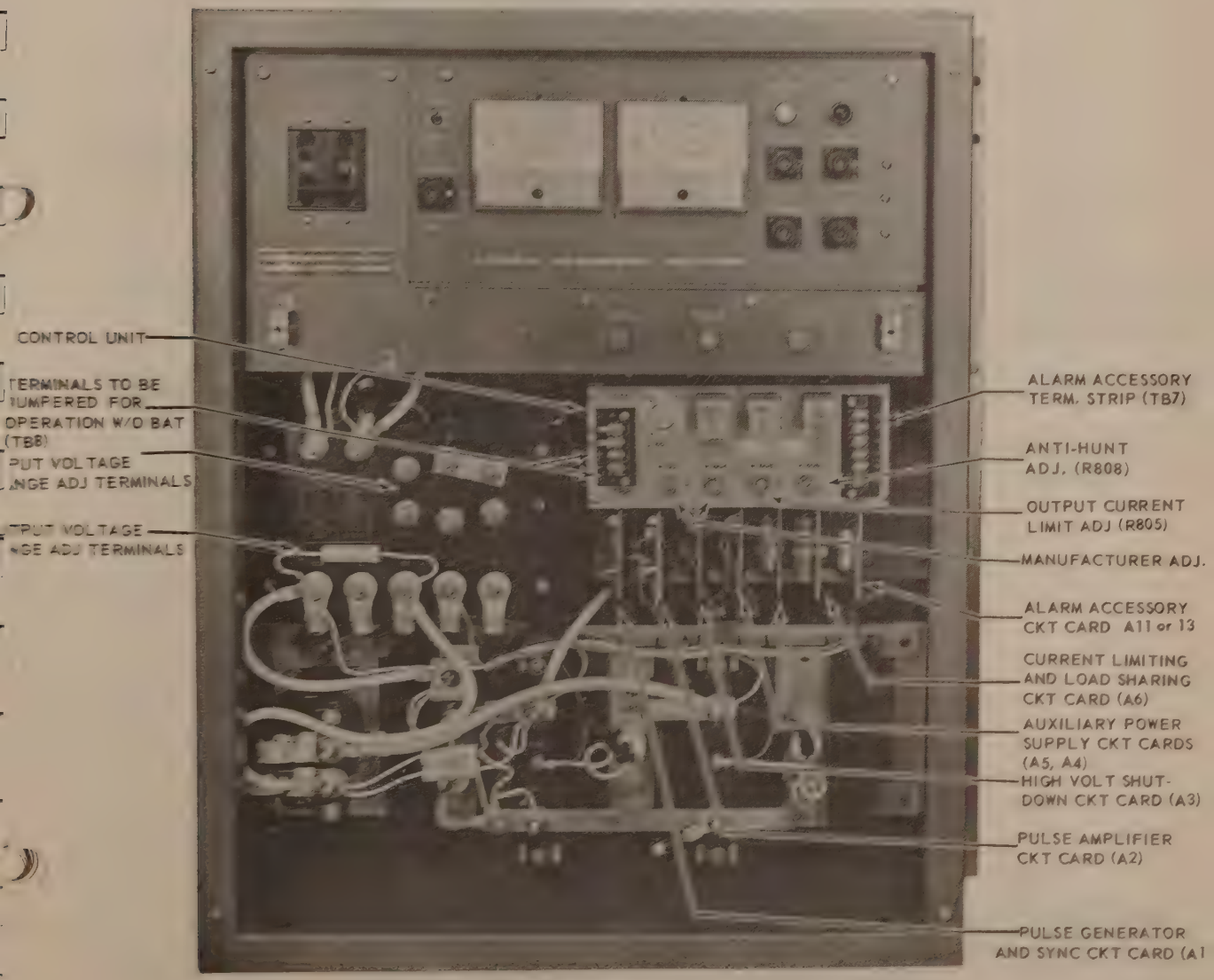

ACCESSORY EQUALIZE TIMER CONNECTION TERMINALS (TB6B)
INPUT VOLT RANGE ADJ TERMINALS
MOUNTING LOCATION OF ACCESSORY EQUALIZE TIMER
OUTPUT VOLT RANGE ADJ TERMINALS
CONTROL UNIT
TERMINALS TO BE JUMPERED FOR OPERATION W/O BAT (TB8)
ALARM ACCESSORY TERMINAL STRIP (TB7)
MANUFACTURER ADJ
ANTI-HUNT ADJ. (R808)
OUTPUT CURRENT LIMIT ADJ (R805)
PULSE AMPLIFIER CKT CARD (A2)
AUXILIARY POWER SUPPLY CKT CARDS (A
CURRENT LIMITING LOAD SHARING CKT.
PULSE GENERATOR AND SYNC CKT CARD (A1)
HIGH VOLT SHUT-DOWN CKT CARD (A
ALARM ACCESSORY CKT CARD (A11 or 13)
TB6 R
TB8
R 804
R 805

MODEL M37F50*
(FRONT COVER REMOVED)

* Model M30F50 and Model M37F50 are physically the same. For this reason, only the M37F50 is shown.

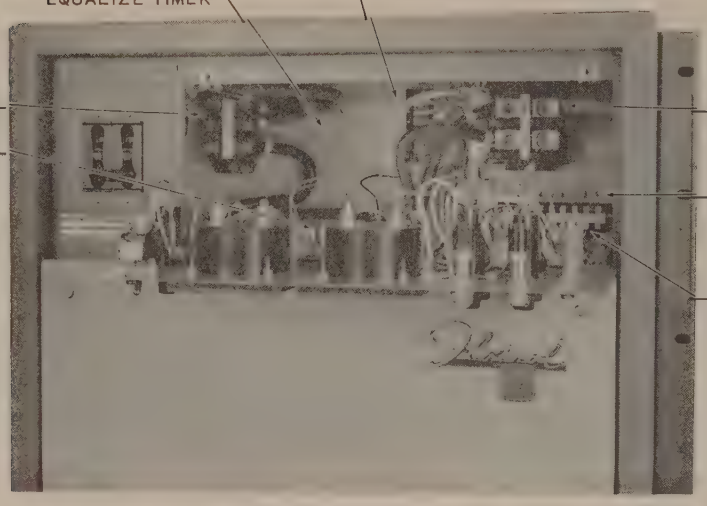

MOUNTING LOCATION OF ACCESSORY EQUALIZE TIMER
OUTPUT TERMINAL BLOCK (TB4)
INPUT TERMINAL BLOCK (TB1)
CONTROL CONNECTION TERMINAL BLOCK (TB5)
OUTPUT FUSE (F3)
FILTER CAPACITOR FUSE (F1)
ACCESSORY EQUALIZE TIMER CONNECTION TERMINALS (TB6)

(METER PANEL OPEN)

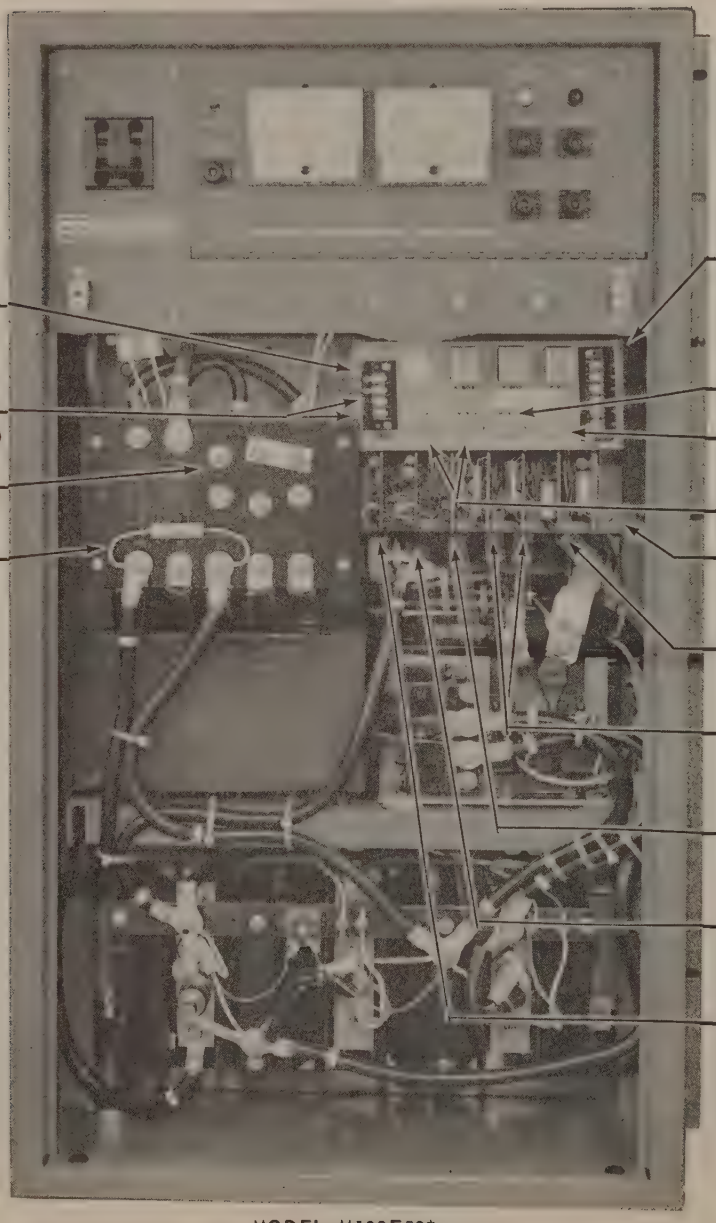

CONTROL UNIT
TERMINALS TO BE JUMPERED FOR OPERATION W/O BAT (TB8)
PUT VOLTAGE NGE ADJ TERMINALS
TPUT VOLTAGE NGE ADJ TERMINALS
ALARM ACCESSORY TERM. STRIP (TB7)
ANTI-HUNT ADJ. (R808)
OUTPUT CURRENT LIMIT ADJ (R805)
MANUFACTURER ADJ.
ALARM ACCESSORY CKT CARD A11 or 13
CURRENT LIMITING AND LOAD SHARING CKT CARD (A6)
AUXILIARY POWER SUPPLY CKT CARDS (A5, A4)
HIGH VOLT SHUT-DOWN CKT CARD (A3)
PULSE AMPLIFIER CKT CARD (A2)
PULSE GENERATOR AND SYNC CKT CARD (A1

MODEL M50F50

(FRONT COVER REMOVED)


MOUNTING LOCATION OF ACCESSORY EQUALIZE TIMER
ACCESSORY EQUALIZE TIMER CONNECTION TERMINALS (TB6)
INPUT TERMINAL BLOCK (TB1)
OUTPUT FUSE (F3)
OUTPUT TERMINAL BLOCK (TB4)
CONTROL CONNECTION TERMINAL BLOCK (TB5)
FILTER CAPACITOR FUSE (F1 below TB5)

(METER PANEL OPEN)


ALARM ACCESSORY TERMINAL STRIP (TB7)
CONTROL UNIT
TERMINALS TO BE JUMPERED FOR OPERATION W/O BAT. (TB8)
OUTPUT CURRENT LIMIT ADJ (R805)
ANTI-HUNT ADJ. (R808)
INPUT VOLTAGE RANGE ADJ TERMINALS
MANUFACTURER ADJ
OUTPUT VOLTAGE RANGE ADJ TERMINALS
ALARM ACCESSORY CKT CARD (A11 or 13)
CURRENT LIMITING AND LOAD SHARING CKT CARD (A6)
AUXILIARY POWER SUPPLY CKT CARDS (A5, A4)
HIGH VOLT SHUT-DOWN CKT CARD (A3)
PULSE AMPLIFIER CKT CARD (A2)
PULSE GENERATOR AND SYNC CKT CARD (A1)

* Model M75F50 and Model M100F50 are physically the same. For this reason, only the M100F50 is shown.

MODEL M100F50*
(FRONT COVER REMOVED)

Diagram or Power Data Sheet furnished in this instruction book. When using 115 volt a-c service, connect the neutral side of the a-c service to the lug on the busbar and the other a-c service lead to terminal "L1"

(d) When using 230 volt a-c service, connect the a-c service leads to terminals "L1" and "L2".

3. g. Control Connections

Control connections are made at terminal block TB5, adjacent to the d-c output terminal block.

(1) Reference Voltage Leads

Control terminals 1 (positive) and 2 (negative) are reference voltage terminals which, unless otherwise specified, are factory-connected to FLOTROL Rectifier output terminals. These connections cause a voltage control circuit to regulate FLOTROL Rectifier output voltage.

In order to take full advantage of the close output voltage regulation characteristics of this FLOTROL Rectifier, the leads connecting terminals 1 and 2 to the output terminals should be disconnected and removed from the FLOTROL Rectifier. Then reference leads (user furnished) can be extended from terminals 1 and 2 to battery or power board at which d-c voltage regulation is required. If voltage drop in FLOTROL Rectifier output leads will exceed 1% of output voltage at full rated output current of FLOTROL Rectifier, reference voltage leads must be extended to hold battery voltage constant.

CAUTION: Polarity of reference voltage leads is critical. If necessary to extend reference voltage leads, make connections carefully to assure that polarity is correct.

When a battery installation contains end cells, these cells are usually charged by a separate end cell charger. After a-c power failure or d-c overload has caused battery discharge, it may be desirable to transfer output of this FLOTROL Rectifier to recharge both normal battery and end cells. Extended reference voltage leads can be connected to permit charging of end cells by method described in the end cell charging procedure in Section 5 g.

(2) Rectifier Paralleling

This FLOTROL Rectifier is equipped with an automatic current limiting circuit. This circuit will enable the paralleling of this FLOTROL Rectifier with any other battery charger which can be adjusted to the same output voltage. The load may not be shared proportionally but when this FLOTROL Rectifier reaches its current limit setting, it will not deliver further current and any additional load must be supplied by the other paralleled battery charger(s).

(3) Load Sharing Circuit

This FLOTROL Rectifier is equipped with a load sharing circuit which will enable it to divide the load in proportion to the output current ratings, with any other FLOTROL Rectifier equipped with a compatible circuit. FLOTROL Rectifiers of 30 ampere or greater capacity have compatible load sharing circuits. When both FLOTROL Rectifiers have compatible load sharing circuits, a load sharing connection is to be made between the load sharing terminals (terminal #3 of the control terminal strip) of each FLOTROL Rectifier. Refer to the Power Data Sheet or the Wiring Diagram for recommended size of the load sharing lead and terminal block capacity. For proper operation, it is essential that each FLOTROL Rectifier be adjusted to the same output voltage, following the procedure outlined below:

(a) Temporarily open the rectifier load sharing lead by removing the load sharing fuses.

(b) With the other paralleled FLOTROL Rectifier(s) turned off, make sure FLOTROL Rectifier No. 1 is adjusted to the required output voltage (with a load somewhere between 1/4 to full load).

(c) With the paralleled Rectifiers turned on but with the load sharing lead open, adjust the output voltage of each paralleled Rectifier until it shares

the load, as nearly as possible in proportion to the ratings with the No. 1 Rectifier. This should assure that all FLOTROL Rectifiers are adjusted to the same voltage.

(d) Reclose the load sharing circuit between all paralleled FLOTROL Rectifiers. This should insure that the FLOTROL Rectifiers will proportionally share the load under all conditions of line voltage and load.

(e) If after the load sharing connections are made, a FLOTROL Rectifier does not share the load in proportion to its rating, it indicates that the paralleling balance potentiometer has been disturbed from its factory setting. Each potentiometer should be somewhere near the center of the range and is adjusted by a screwdriver adjustment shaft PAR. BALANCE. After it is assured that the Rectifiers have all been adjusted to the same output voltage by the method indicated above, this PAR. BALANCE adjustment may be readjusted. The adjustment should be made to the PAR. BALANCE adjustment potentiometer of the FLOTROL Rectifier that appears to have been moved from its normal central position. To increase portion of charging current supplied by this FLOTROL Rectifier, slowly turn its PAR. BALANCE shaft clockwise; to decrease portion of charging current furnished by this FLOTROL Rectifier, slowly turn shaft counterclockwise.

(4) Power Alarm

Terminals 4 to 5 furnish a closed-loop circuit, and a closed-loop circuit between terminals 5 to 6 is broken to extend an alarm in event of an a-c power failure.

(5) Remote Control

If this FLOTROL Rectifier has an accessory power relay, it is necessary to supply 48 volt d-c between terminals 7 and 8 to operate the relay.

(6) Accessory Alarm Relay Connections

If furnished, a charge failure alarm relay or a high-low voltage alarm relay actuates closed circuits across terminals 4 and 5 and terminals 7 and 8 of terminal strip TB7; also, circuits are broken between terminals 3 and 4 and terminals 6 and 7.

(7) Connections, Operation W/O Battery or with a Highly Discharged Battery

When this FLOTROL Rectifier is to be operated without battery, a jumper connection must be made between terminals 1 and 2 of terminal strip TB8. This connection is necessary to enable the FLOTROL Rectifier to start when not connected to battery. If this FLOTROL Rectifier is to be operated with a highly discharged battery (battery voltage below 40VDC), the FLOTROL Rectifier may not start and it will be necessary to jumper terminals 1 to 2 of TB8. When battery voltage exceeds 40VDC, the jumper should be removed.

h. Installation Check

(1) To turn on FLOTROL Rectifier, throw toggles of A-C INPUT circuit breakers to ON position. Note d-c output voltage and output current as indicated by voltmeter and ammeter.

(2) Check settings of battery float voltage and charge-equalize voltage. Reset, if necessary. Refer to the battery-float voltage and charge-equalize adjustment procedure in Sections 4 d and e.

ADJUSTMENTS

a. General

Unless otherwise specified, these FLOTROL Rectifiers are factory adjusted to float charge a 24 cell battery at 2.17 volts per cell, and operate from 211 to 257 volts a-c input.

Input voltage range and cell setting adjustments are made by connections to terminal board TB2 attached to power transformer T1. Float output voltage, equalize output voltage, and parallel balance adjustment potentiometers are on the meter panel of the M30F50 and M37F50 FLOTROL Rectifiers, and are accessible at front of the M50F50, M75F50 and M100F50 FLOTROL Rectifiers with front cover removed.

To gain access to these adjustments, release two screw-type fasteners below meter panel, lift front cover upward to withdraw two retaining studs at bottom of cover from corresponding slots of cabinet, and remove cover from cabinet.

b. Input Voltage Range

This adjustment is made by terminal link connections on an adjustment terminal board.

(1) If possible, determine range over which a-c power voltage varies. Usually one of two nominal 115 volt, or one of two nominal 230 volt input voltage ranges will be better suited to prevailing a-c power voltage. Refer to paragraph concerning Power Connections in Section 3 f (2) for proper connection of input terminal block busbar jumper.

NOTE: If either of two input voltage range settings are suited to prevailing a-c service voltage, higher input voltage range will give better power factor.

(2) Select required input voltage range setting by connection of terminal links between terminals of transformer T1 terminal board TB2 as follows:

Input Voltage Range	Adjustment Connection
94 to 114	A to F, D to E
105 to 129	A to B, C to D
187 to 229	E to F
211 to 257	B to C

c. Output Voltage Range

Output voltage range is selected by connection of adjustment lead J at one of CELLS terminals 23, 24, 25 or 26 of transformer T1 terminal board, in accordance with number of cells in battery to be charged. This adjustment setting must be made correctly to obtain constant d-c voltage at battery or power board at which it is required.

If this Rectifier is to be used to charge end cells in addition to the normal battery, the connections to the CELL terminals in the Rectifier should be made permanently at the 26 CELLS terminal. This setting will not affect regulation at 23 cells but will improve regulation when charging 26 cells. The only disadvantage of charging 23 cells when the cell setting is on 26 CELLS is a poorer power factor. Refer also to the End Cell Charging instructions in Section 5 g.

d. Battery Float Voltage

Potentiometer FLOAT VOLTAGE sets value of d-c voltage which this FLOTROL Rectifier will maintain constant at battery or power board at which it is required. Setting of this potentiometer should be changed only in small increments. Before adjustment is made, be certain that battery is fully charged.

(1) To increase battery float voltage, turn screwdriver adjustment shaft of potentiometer FLOAT VOLTAGE clockwise; to decrease battery float voltage, turn shaft counter-clockwise.

(2) When setting of potentiometer FLOAT VOLTAGE has been changed, allow battery voltage to stabilize at its new value, then note whether this value is as desired.

(3) Repeat Steps (1) and (2), above, as necessary to obtain required battery float voltage.

e. Charge-equalize Voltage

Potentiometer EQUALIZE VOLTAGE sets voltage supplied to recharge battery after discharge, or to equalize charge of all battery cells. This adjustment is separate from, and it does not affect setting of, potentiometer FLOAT VOLTAGE.

(1) To obtain charge-equalize voltage. throw toggle of FLOAT-EQUALIZE switch to EQUALIZE position.

(2) Allow d-c output voltage of FLOTROL Rectifier to stabilize at its new value. To increase charge-equalize voltage, turn screwdriver adjustment shaft of potentiometer EQUALIZE VOLTAGE clockwise; to decrease charge-equalize voltage, turn shaft counterclockwise.

(3) Repeat Step (2), above, as necessary to obtain desired charge-equalize voltage.

f. Output Current Limit

The value at which an output current limiter will prevent further increase of output current is set by means of potentiometer R805. This potentiometer, which is located on the control unit of the Rectifier, can be set to limit the output current at any value between approximately 90% and 120% of its rated value. The current limit is factory set at approximately 110% of rated current value. To change the current limit setting, the following procedure should be followed:

(1) If the load on the FLOTROL Rectifier is not greater than the desired current limit setting, an artificial load should be used to insure that the amount of load exceeds the desired current limit setting.

(2) To decrease the current limit setting, turn adjustment shaft of R805 counterclockwise until the output current drops to the desired limit. To increase the current limit setting, turn adjustment shaft of R805 clockwise until the output current rises to the desired limit.

CAUTION: Do not adjust the output current limit to a value greater than 120% of the FLOTROL Rectifier rating. In event of extremely high ambient temperature conditions, the output current limit setting should not exceed rated output current of the FLOTROL Rectifier. This will protect the FLOTROL Rectifier from damage.

g. Rectifier Paralleling Balance

Refer to the Rectifier Paralleling and Load Sharing procedure in Section 3 g.

h. Equalize Charge Timer

When an accessory equalize charge timer is installed, it can be adjusted to time an equalize charge period up to 24 hours (recommended minimum setting 2-1/2 hours). If the equalize charge period was specified on the order, it has been set as required. If no equalize charge period was specified, it has been set at 4 hours.

The equalize timer is located behind the meter panel. Remove two retaining screws and cover from the timer.

To adjust timer M3, loosen the dial locking device and turn calibrated dial so that desired equalize charge period is aligned opposite index marker. Tighten the dial locking device to retain the setting.

i. High Voltage Shutdown Circuit Adjustment

This adjustment sets value at which d-c output current will be turned off if output voltage reaches a preset value. This adjustment was made at the factory. If the high voltage shutdown limit was specified on the order, this has been adjusted as requested. If no limit was specified, and it was known that the Rectifier was to be

(continued)

used with normal battery only or as a battery eliminator, the high voltage shutdown circuit was set at 60 volts; if it was known that the Rectifier was to be used to charge end cells in addition to the normal battery, the high voltage shutdown circuit was set at 65 volts. Should it become necessary to change this setting, use the following procedure:

(1) Turn FLOTROL Rectifier off, disconnect battery (or load if used as a battery eliminator) from output terminals of the unit. If reference voltage leads are extended, reconnect them to output terminals of FLOTROL Rectifier. If the FLOTROL Rectifier was being used as a battery charger, jumper TB8 terminals 1 to 2.

(2) Turn adjustment screw of R304 on card A3 fully clockwise. With the Rectifier turned on, note the float voltage setting, then throw FLT-EQ switch to the EQ position and note the equalize voltage setting.

(3) Adjust output voltage by means of EQUALIZE VOLTAGE potentiometer to get the desired shutdown voltage. If the desired voltage cannot be obtained with the EQUALIZE VOLTAGE potentiometer fully clockwise, it will be necessary to turn the FLOAT VOLTAGE potentiometer in a clockwise direction to obtain the desired shutdown voltage.

(4) Apply 5 to 50% load, slowly turn adjustment screw of R304 in a counterclockwise direction until high voltage shutdown occurs. Note output voltage at which the high voltage shutdown occurs. If shutdown occurs at a lower value than desired, turn R304 potentiometer slightly clockwise; turn EQUALIZE VOLTAGE potentiometer fully counterclockwise and A-C INPUT circuit breaker to OFF and back to ON position to reset K802. Slowly increase output voltage by means of EQUALIZE VOLTAGE potentiometer and note value when shutdown occurs. Repeat this process until the desired shutdown voltage is reached.

NOTE: A slight time delay may be experienced before shutdown occurs.

(5) Readjust both the EQUALIZE and FLOAT potentiometers as necessary to obtain the original equalize and float voltage settings.

(6) Extend voltage reference leads if desired. If the FLOTROL Rectifier is to be used as a battery charger, remove jumper connecting TB8 terminals 1 to 2.

4. j. Accessory High-low Voltage Alarm Assembly Adjustment

If a high-low voltage alarm assembly is provided, potentiometers R1306 and R1309 on plug-in card A13 set the d-c output voltages at which the respective low and high voltage alarms are given. When alarm voltages are not specified on original order, potentiometer R1306 is adjusted to give an external alarm when d-c output voltage drops to approximately 2.05 volts per cell. Similarly, potentiometer R1309 is adjusted to give an alarm at approximately 2.30 volts per cell. These adjustments are performed at the factory, and no further adjustments should be required.

If it becomes necessary to change either of the voltage settings, the following procedure should be used:

(1) Turn FLOTROL Rectifier off, disconnect battery (or load if used as a battery eliminator) from output terminals of the unit. If reference voltage leads are extended, reconnect them to output terminals of FLOTROL Rectifier. If the FLOTROL Rectifier was being used as a battery charger, jumper TB8 terminals 1 to 2.

(a) To adjust value at which the low voltage alarm is given:

1. Turn adjustment screw of R1306 full counterclockwise and R1309 fully clockwise. With the Rectifier turned on, note the float voltage setting. Set output voltage by means of FLOAT VOLTAGE potentiometer to value at which the low voltage alarm is desired.

2. With R1306 fully counterclockwise, lamp RECT FAIL should be extinguished. After Rectifier output voltage is adjusted to value at which the low voltage alarm is desired, turn R1306 on plug-in card A13 clockwise until lamp RECT FAIL lights. Increase Rectifier output voltage slightly higher than value at which the low voltage alarm was desired; lamp RECT FAIL should extinguish. Repeat this process until the desired alarm setting is reached.

3. Reset original float voltage setting.

(b) To adjust value at which a high voltage alarm is given:

1. With the Rectifier turned on, note the float voltage setting, then throw FLT-EQ switch to EQ position and note the equalize voltage setting. Set output voltage by means of the EQUALIZE VOLTAGE potentiometer to value at which the high voltage alarm is desired. If the desired voltage cannot be obtained with the EQUALIZE VOLTAGE potentiometer fully clockwise, it will be necessary to turn the FLOAT VOLTAGE potentiometer in a clockwise direction to obtain the desired alarm voltage.

2. With R1309 fully clockwise, lamp RECT FAIL should be extinguished. After FLOTROL output voltage is adjusted to value at which the high voltage alarm is desired, turn R1309 on plug-in card A13 counterclockwise until alarm lamp RECT FAIL lights. Reduce Rectifier output voltage slightly lower than value at which the high voltage alarm was desired; lamp RECT FAIL should extinguish. Repeat this process until the desired alarm setting is reached.

3. Readjust both the original equalize and float voltage settings.

(2) Extend voltage reference leads if desired. If the FLOTROL Rectifier is to be used as a battery charger, remove jumper connecting TB8 terminals 1 to 2.

k. Anti-hunt Adjustment

Oscillation of output current or output voltage under adverse operating conditions may be corrected by adjustment of the anti-hunt adjustment potentiometer R808. This potentiometer is located on the control unit of the FLOTROL Rectifier.

l. Manufacturer Adjustments

Special manufacturer adjustments are made on each FLOTROL Rectifier. It is recommended that no change be made in these adjustment settings:

(1) Potentiometer R801 sets range over which potentiometers FLOAT VOLTAGE and EQUALIZE VOLTAGE will adjust battery float voltage and charge-equalize voltage.

(2) Potentiometer R804 sets range over which potentiometer R8 will adjust Rectifier load sharing voltage. With potentiometer R8 at its midpoint and FLOTROL Rectifier delivering rated output current, potentiometer R804 is adjusted so that 8 volts d-c will appear between Rectifier load sharing terminal 3 and negative d-c output.

5. OPERATION

a. General

Since this FLOTROL Rectifier operates without moving parts, it does not require periodic maintenance or adjustment. Operating procedures are described below.

b. Starting and Stopping

To turn FLOTROL Rectifier on or off manually, throw toggles of A-C INPUT circuit breaker to ON position or OFF position. If this FLOTROL Rectifier has an accessory remote control relay, and it is turned on or off from a remote control position, toggles of A-C INPUT circuit breaker must be left in ON position.

NOTE: If battery voltage is less than 40VDC, the FLOTROL Rectifier may not start and it will be necessary to connect the "M" option jumper to TB8 terminals 1 to 2 until battery voltage rises above 40VDC. When battery exceeds 40VDC, the "M" option jumper should be removed.

5. c. Metering

D-c output voltage and output current are indicated by a voltmeter and an ammeter. Voltmeter indication will, however, exceed battery voltage by any voltage drop which appears in d-c output leads.

d. Recharge, Equalize Charge

High d-c voltage is sometimes required to recharge discharged battery cells, or to equalize charge of all battery cells. To obtain this voltage from this FLOTROL Rectifier, throw toggle of FLOAT-EQUALIZE switch to EQUALIZE position; to restore usual battery float operation, throw toggle to FLOAT position. If this FLOTROL Rectifier has an accessory equalize charge timer, battery float operation will be restored automatically after a preset interval.

CAUTION: Do not supply recharge or equalize charge voltage for a longer period than necessary. Prolonged higher charge voltage will overcharge battery cells and reduce battery life. Refer to battery manufacturer's instructions to obtain recommended equalize charge interval and period.

e. Equalize Charge Timer Accessory

When an equalize charge timer is to be used to time an equalize charge period, the following procedure should be used:

(1) Set timer for desired charge period (see Section 4 h.).

(2) Throw FLOAT-EQUALIZE switch to the EQUALIZE position.

(3) When equalize charge period expires, the Rectifier will automatically resume float operation. (FLOAT-EQUALIZE switch will remain in the EQUALIZE position).

(4) The FLOAT-EQUALIZE switch should be manually returned to the FLOAT position after the equalize charge period has expired.

In event of an a-c power failure during the equalize charging period, the timer will repeat its complete timing cycle when the a-c service is restored.

f. Manual Output Voltage Regulation Accessory

This accessory can be used to manually regulate the output voltage of the FLOTROL Rectifier. This manual adjustment will only set the output voltage to the correct value for only one given condition of a-c input voltage and output current; any variation of input voltage or output current will then cause the output voltage to vary. To regulate the charging voltage manually:

(1) Turn off FLOTROL Rectifier and open front cover.

(2) Remove circuit card A2 from the control unit of the FLOTROL Rectifier.

(3) Plug the manual control circuit card into the A2 circuit card receptacle.

(4) Adjust potentiometer R2003 on the manual control circuit card as necessary to obtain the desired output voltage.

To restore automatic regulation of charging voltage, replace the manual control circuit with circuit card A2 which was removed in Step 2.

5. g. High-Voltage Shutdown

This FLOTROL Rectifier has a circuit which monitors output voltage continuously, and shuts off d-c output current if output voltage should increase to the preset value. High-voltage shutdown causes an alarm as described above. After shutoff has been made, to reset, throw toggles of A-C INPUT circuit breaker first to OFF position, wait a minimum of two seconds, then return to ON position; repeated shutdown shows a failure which causes excessive d-c output voltage.

h. End Cell Charging

In a battery installation which includes end cells, after a-c power failure or d-c overload has caused battery discharge, it may be desirable to transfer output of this FLOTROL Rectifier to charge both normal battery and end cells. Necessary wiring connections to battery, load and two switches, not furnished with this FLOTROL Rectifier are shown in Figure 1. Note that the extended reference leads are always connected across normal battery only.

As battery voltage decreases through discharge, load switch SW2, Figure 1, is thrown to its lower position to connect end cells in series with normal battery and load to maintain load voltage. To charge end cells connected in this manner, throw output switch SW1 to its lower position. This transfers the output of FLOTROL Rectifier across normal battery plus end cells. The output voltage will increase to maintain regulated voltage across normal battery while end cells are also charging.

As battery voltage increases through recharging, load switch SW2 is thrown back to its upward position to transfer d-c load back to normal battery and limit load voltage. At this time, output switch SW1 should be thrown back to its upper position to transfer FLOTROL Rectifier output back to normal battery only.

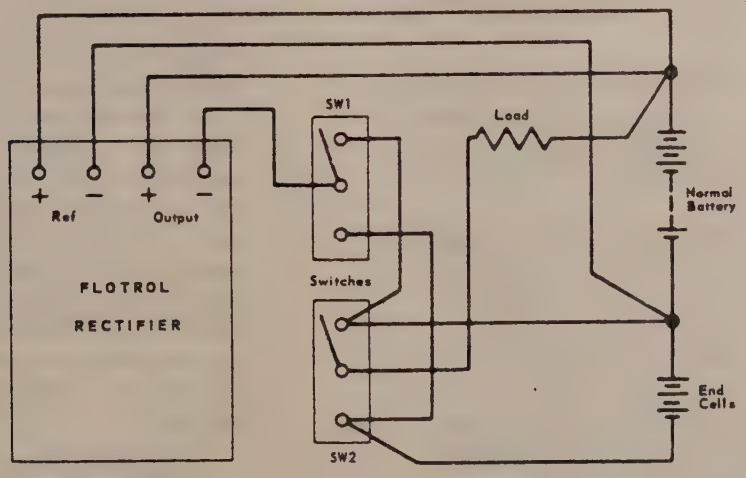


Figure 1 End Cell Charging

NOTE: If desired, once load switch SW2 has been returned to its upward position, end cells can be charged quickly by leaving output switch SW1 in its lower position; this connects end cells in series between FLOTROL Rectifier output and d-c load. Since this results in high end cell charging current, end cells should be checked continuously to avoid overcharging.

i. Alarm Indications

(1) RECT FAIL indicator lamp DS2 lights and an external power alarm is given (terminals 4-6 on TB5), if connected, when any of the following conditions occur:

(a) When the a-c input power fails.

(b) When the Rectifier is shut "OFF" (CB1-2 in "OFF" position).

(c) When the control circuit fuse F5 fails.

(d) If d-c output voltage increases to an excessive value (high voltage shutdown).

(e) In the event of an output current failure and the charge fail alarm accessory is furnished.

(f) When a high-low voltage alarm accessory is furnished and the output voltage goes below a value set by potentiometer R1306 or above a value set by potentiometer R1309. This alarm indication will appear only as long as the high or low voltage condition exists.

(2) A power alarm is also extended, if connected, (terminals 4-6 on TB5) when any of the following occurs:

(a) When the a-c input power fails.

(b) When the Rectifier is turned "OFF" (CB1-2 in "OFF" position).

(c) When fuse F5 opens.

(3) If filter capacitor fuse F1, d-c control fuse F2, output fuse F3, or Rectifier load sharing fuse F4 should open, indicator lamp FUSE ALARM (DS1) will light.

j. Fuses, Circuit Breakers

A-C INPUT circuit breaker CB1-CB2 protects against excessive a-c input current. If the circuit breaker should open, this will be reflected by movement of its toggle from ON position to OFF position. To reset the circuit breaker, throw toggle to ON position.

Fuse F1 protects against a short-circuit in output filter capacitor bank C2; if fuse F1 should open, indicator-alarm fuse F1A will also open. Fuse F2 is connected in series with voltmeter M1. Fuse F3 protects against excessive d-c output current; if fuse F3 should open, fuse F3A will also open. Fuse F4 protects against excessive Rectifier load sharing current in an installation in which two or more FLOTROL Rectifiers with compatible load sharing are connected to operate in parallel. Fuse F5 protects the control unit.

Fuses F1A, F2, F3A, F4 and F5 are accessible on the meter and control panel of the FLOTROL Rectifier.

To gain access to fuses F1 and F3, release two screw-type fasteners below meter panel, lift front cover upward to withdraw two retaining studs at bottom of cover from corresponding slots of cabinet, and remove cover from cabinet. Release the screw-type fastener(s) on meter panel and pivot panel upward on its hinge.

The table below lists the fuses and circuit breakers used in the various Large Single Phase "M" Series FLOTROL Rectifiers. If it becomes necessary to replace any fuse, replace only with proper fuse type and size as follows, or equivalent:

M30F50			M37F50		
FUSE CKT BKR	TYPE	RATING (AMPS)	FUSE CKT BKR	TYPE	RATING (AMPS)
F1	BUSSMANN BAF	20	F1	BUSSMANN BAF	20
F2,F5	70A	1-1/3	F2,F5	70A	1-1/3
F3	BUSSMANN KAH	40	F3	BUSSMANN KAH	50
F4	70F	1/4	F4	70F	1/4
F1A,F3A	70K	1/4	F1A,F3A	70K	1/4
CB1	—	40	CB1	—	40
CB2	—	20	CB2	—	20

M50F50			M75F50		
FUSE CKT BKR	TYPE	RATING (AMPS)	FUSE CKT BKR	TYPE	RATING (AMPS)
F1	BUSSMANN FRN	30	F1	BUSSMANN NON	50
F2,F5	70A	1-1/3	F2,F5	70A	1-1/3
F3	BUSSMANN ACK	60	F3	BUSSMANN ACK	100
F4	70F	1/4	F4	70F	1/4
F1A,F3A	70K	1/4	F1A,F3A	70K	1/4
CB1	—	50	CB1	—	90
CB2	—	25	CB2	—	40

M100F50		
FUSE CKT BKR	TYPE	RATING (AMPS)
F1	BUSSMANN FRN	60
F2,F5	70A	1-1/3
F3	BUSSMANN ACK	120
F4	70F	1/4
F1A,F3A	70K	1/4
CB1	—	100
CB2	—	50

k. Component Boards

Any of the component boards in this FLOTROL Rectifier can easily be replaced as individual assemblies in event of a defective component on a component board.

To gain access to component boards, release two twist-type fasteners below meter panel, lift cover upward to withdraw two retaining studs from corresponding slots in cabinet and remove cover from cabinet.

Component Board	Description
A1	Pulse generator and synchronizing circuit
A2	Pulse amplifier
A3	High voltage shutdown circuit
A4, A5	Auxiliary power supply
A6	Current limiting and load sharing circuit
A11	Optional charge failure alarm circuit
A13	Optional high-low voltage alarm circuit

6. CIRCUIT DESCRIPTION, GENERAL

The schematic diagram shows the electrical circuits of the FLOTROL Rectifier. Figure 2 of these instructions indicates the functional circuits in block form.

a. Power Circuit

(1) Power Transformer

A-c power flows from a-c input, through input circuit breakers to power transformer T1. Transformer T1 reduces a-c line voltage to a lower value required by the power rectifier.

(2) Power Rectifier

Diodes CR2, CR3 and thyristors CR4 and CR5 make up a full-wave bridge power rectifier. The power rectifier changes alternating current supplied by transformer T1 to direct current which is then filtered and supplied to the load.

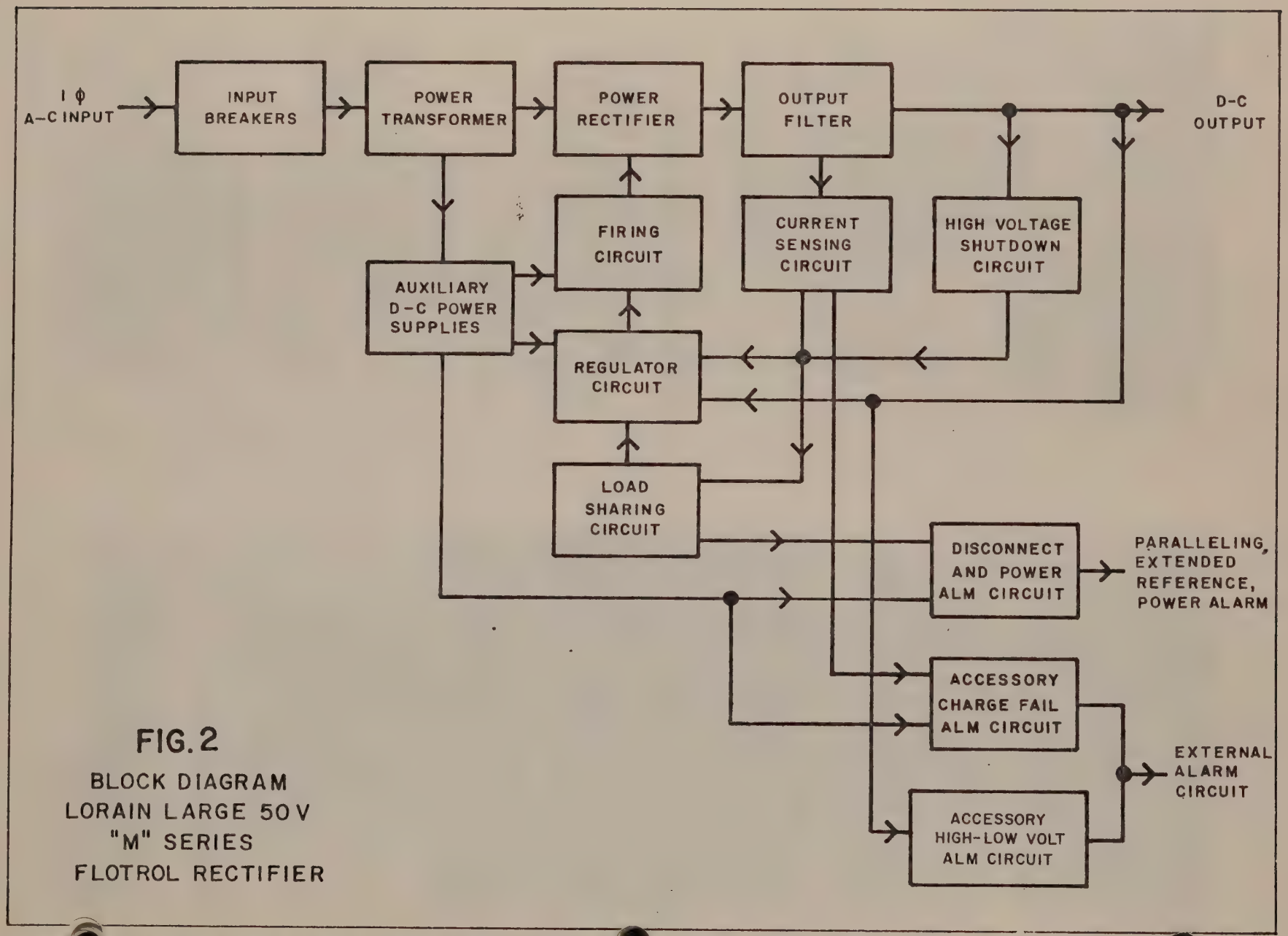


FIG. 2

BLOCK DIAGRAM
LORAIN LARGE 50 V
"M" SERIES
FLOTROL RECTIFIER

(3) Output Filter

Capacitor bank C2 and chokes L1-2 form an output filter which smooths out the ripple voltage from the power rectifier. This causes the output voltage to approach pure d-c.

b. Voltage Regulator Circuit

Reference leads furnish output voltage across a series resistance network consisting of R801, R806, R6, and R7. A portion of this network voltage is compared by a differential amplifier consisting of Q101 and Q102 to a constant voltage developed across zener diode CR103 in the regulator circuit (circuit card A1). The difference between these two voltages is amplified and fed to Q104. Transistor Q104, in turn, controls the operation of the pulse generator (relaxation oscillator transistor Q103) which generates the firing pulses for the thyristors. The pulse generator is synchronized to the a-c line by means of zener diode CR104 and the regulator power supply circuit card A4.

c. Pulse Amplifier

The pulse amplifier circuit (circuit card A2) is used to amplify the amplitude and increase the duration of the firing pulses from the pulse generator. The amplified pulses are then fed to the gates of thyristors CR4 and CR5.

d. High Voltage Shutdown Circuit

When the output voltage reaches the value determined by resistor R304, transistor Q301 conducts, and causes relay K301 to operate. Contacts of relay K301, operated, complete a circuit to thyristor CR302 causing it to conduct. The conduction of CR302 shorts the coil of relay K802, causing it to release. Contacts of relay K802, released, disable the firing pulses to thyristors CR4 and CR5. Coil voltage for relay K802 is supplied by a full-wave center tapped rectifier located on circuit card A5.

e. Current Limiting and Load Sharing Circuit

The center-leg winding of saturable reactor L3 is connected in series with negative FLOTROL Rectifier output. Saturable reactor L3 is designed so that current in this winding will cause it to approach saturation, then become saturated, as FLOTROL Rectifier output current increases beyond its rated maximum value.

Two end leg windings of saturable reactor L3 are connected in series with primary winding of transformer T802 across a-c supplied by power transformer T1. So long as L3 remains unsaturated, most of this voltage appears across L3 end leg windings while T802 primary voltage remains low. However, as L3 approaches saturation, L3 end leg winding voltage decreases to increase T802 primary voltage.

T802 secondary voltage is applied to two individual center-tapped full wave rectifier circuits on circuit card A6. One of the center-tapped rectifiers (diodes CR603-604) supplies voltage across the current limiting adjustment potentiometer R805. A portion of R805 voltage is then applied to the voltage regulator circuit on card A1. In the event of an overload condition, the proportional increase in T802 secondary current results in an increase in R805 voltage. When R805 voltage reaches a preset value, the regulator circuit delays the thyristor firing pulses supplied to the gate terminals of the thyristors, reducing their conduction time and preventing a further increase in output current.

When two or more FLOTROL Rectifiers are connected for parallel operation, the units are connected together by means of a load sharing (PAR) lead. The second center-tapped rectifier (diodes CR601-602) on card A6 supplies a voltage proportional to the load current to a paralleling circuit composed of potentiometers R804, R8, transistor Q801 and a load sharing lead. Bias for this circuit is supplied by a full-wave center-tapped rectifier (diodes CR506-507) on circuit card A5.

The settings of R804 and R8 determine the amount of bias supplied to transistor Q801, thereby controlling the amount of current flowing in the load sharing lead between the FLOTROL Rectifiers and to the regulator circuit of each unit. If one of the paralleled units starts to deliver more than its rated share of the load, the current flowing in this lead will cause the regulator circuit in the FLOTROL Rectifier supplying more than its rated share of the load to decrease its output voltage while the regulator circuit in the other FLOTROL Rectifier causes its output voltage to increase, thereby equalizing the voltage.

f. Self-starting Circuit

A center-tapped full-wave bridge rectifier on circuit card A5 supplies voltage to start the unit when there is no voltage on the sensing leads. When the FLOTROL Rectifier is used to charge a battery, the self-starting lead is opened by removing the "M" option jumper from TB8 terminals 1 and 2.

g. Disconnect Relay

A secondary winding of transformer T801 supplies a-c to a rectifier (diodes CR504-505) on circuit card A5 which rectifies this a-c to operate a disconnect relay (K803). With the FLOTROL Rectifier in operation, contacts of the disconnect relay complete the following circuits: load sharing circuit, reference circuit and closed circuit between POWER ALARM terminals NO and C. Should there be an a-c power failure or if the FLOTROL Rectifier is turned off, the disconnect relay releases and these circuits are broken. Additional contacts of this relay, released, cause lamp RECT FAIL to light and close a circuit between POWER ALARM terminals NC and C.

h. Accessory Alarm Circuits

(1) Charge Failure Alarm Accessory, Circuit Card A11 and Relay K801

The charge failure alarm circuit senses the output ripple across a winding of choke L1. This ripple current causes the charge failure alarm circuit to operate relay K801. If the charging current should decrease to no load, the charge failure alarm circuit senses a decrease in ripple current and releases the relay. Contacts of relay K801, released, complete negative voltage path to light lamp RECT FAIL, close circuits between terminal strip TB7 terminals 4 to 5 and 7 to 8 and open circuits between TB7 terminals 3 to 4 and 6 to 7.

(2) High-low Voltage Alarm Accessory, Circuit Card A13 and Relay K801

Alarm relay K801 is normally operated. It releases to extend an external alarm when FLOTROL Rectifier output voltage either increases or decreases to preset values.

Two voltage sensing networks compare a portion of the output voltage with a constant voltage developed in the high-low voltage alarm circuit.

Should the output voltage decrease to value determined by the setting of potentiometer R1306, or increase to value determined by the setting of potentiometer R1309, relay K801 releases to light lamp RECT FAIL, close circuits between terminal strip TB7 terminals 4 to 5 and 7 to 8 and open circuits between TB7 terminals 3 to 4 and 6 to 7.

LORAIN PRODUCTS CORPORATION
Lorain, Ohio, U.S.A.

LORAIN PRODUCTS (CANADA) LTD.
St. Thomas, Ontario, Canada

August 24, 1973

TROUBLESHOOTING INSTRUCTIONS
LORAIN "M" SERIES, SINGLE PHASE FLOTROL RECTIFIERS
6, 12, 18, 25, 30, 37, 50, 75, AND 100 AMPERE, 50 VOLT MODELS

GENERAL

These troubleshooting instructions consist of two separate sections which, when used together, should help isolate failures in the Rectifier.

The first section is a "branch-type" trouble chart which makes use of the various Rectifier alarm lamps to rapidly isolate the trouble condition to the most probable trouble causes.

The second section of the troubleshooting procedure contains specific repair procedures referenced on the trouble chart.

Whenever a specific repair procedure number is listed on the trouble chart, proceed to the repair procedure in section two which corresponds to the repair procedure number given on the trouble chart.

EXPLANATION OF RECTIFIER TROUBLE CHART

The "branch-type" trouble charts, which follow, help isolate Rectifier malfunctions by use of various equipment alarm lamps. By observing the various alarm lamps which are illuminated, the trouble condition can be rapidly isolated to the most probable causes. Two trouble charts are included in these troubleshooting instructions. Use the chart which agrees with the model Rectifier in service.

An explanation of how to use this chart in isolating trouble is given below.

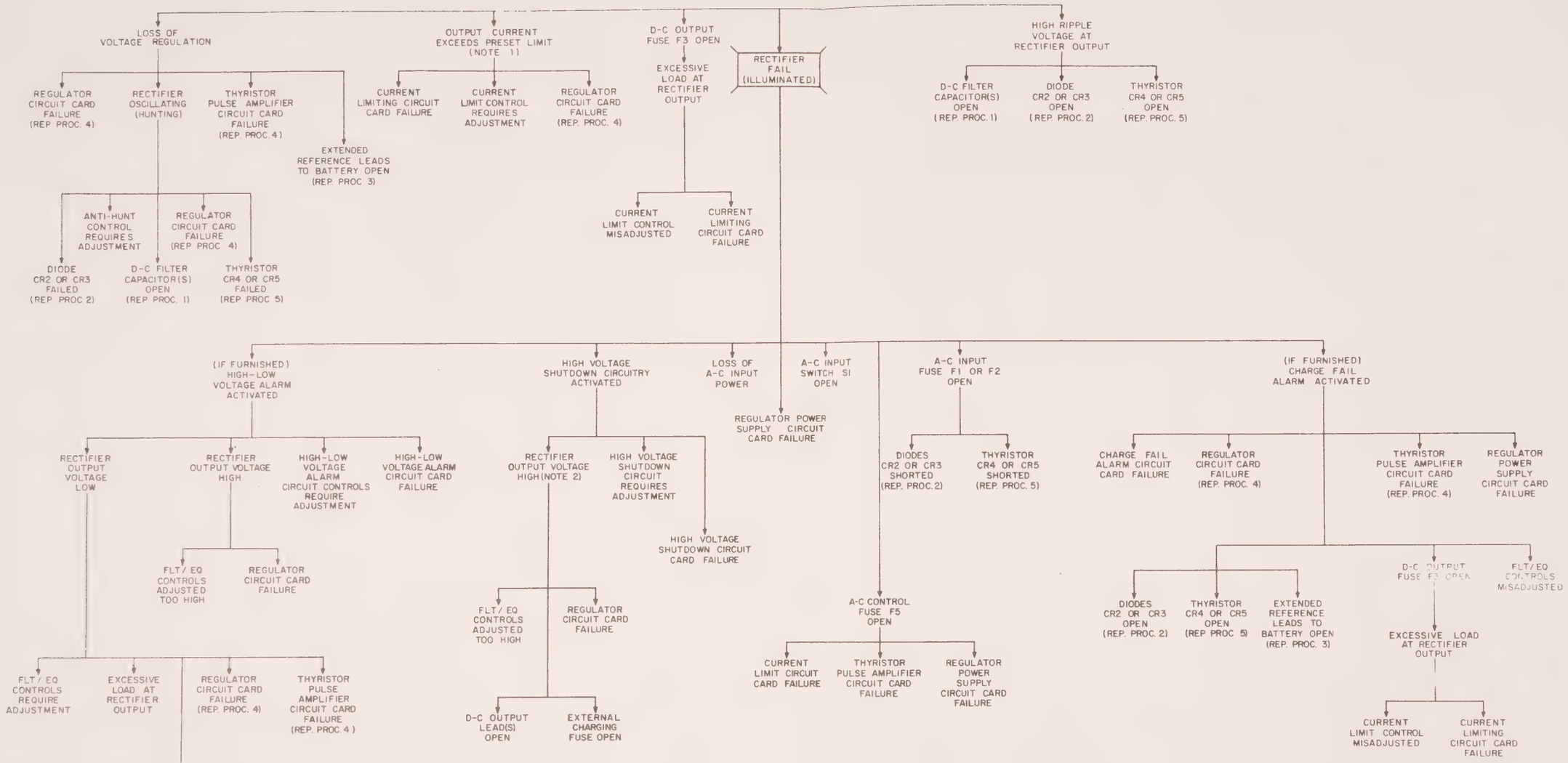
(1) The chart should be read from the top to the bottom; that is, in the direction of the arrows. A trouble symptom, indicated by a visual alarm and/or an irregular Rectifier operating condition, is followed by the most probable causes for the problem.

NOTE: All lamps used on the trouble chart are represented by the symbol with the lamp designation enclosed in the symbol.

(2) When the trouble is isolated down to a plug-in printed circuit card, the card should be replaced. No attempt should be made to troubleshoot or repair the circuit cards.

(3) If the trouble is suspected to be caused by an out of adjustment condition, the adjustment setting should be checked using the adjustment procedure in the respective instruction manual.

(4) Certain trouble conditions may not require specific check procedures (e.g., open fuses), therefore, no additional information is given. If a specific procedure is required to check certain trouble conditions, a repair procedure number on the chart will reference to a specific repair procedure contained in the Rectifier Repair Procedures section of these troubleshooting instructions.


LOSS OF VOLTAGE REGULATION
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
RECTIFIER OSCILLATING (HUNTING)
ANTI-HUNT CONTROL REQUIRES ADJUSTMENT
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
DIODE CR2 OR CR3 FAILED (REP. PROC. 2)
D-C FILTER CAPACITOR(S) OPEN (REP. PROC. 1)
THYRISTOR CR4 OR CR5 FAILED (REP. PROC. 5)
THYRISTOR PULSE AMPLIFIER CIRCUIT CARD FAILURE (REP. PROC. 4)
EXTENDED REFERENCE LEADS TO BATTERY OPEN (REP. PROC. 3)
OUTPUT CURRENT EXCEEDS PRESET LIMIT (NOTE 1)
CURRENT LIMITING CIRCUIT CARD FAILURE
CURRENT LIMIT CONTROL REQUIRES ADJUSTMENT
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
D-C OUTPUT FUSE F3 OPEN
EXCESSIVE LOAD AT RECTIFIER OUTPUT
CURRENT LIMIT CONTROL MISADJUSTED
CURRENT LIMITING CIRCUIT CARD FAILURE
RECTIFIER FAIL (ILLUMINATED)
HIGH RIPPLE VOLTAGE AT RECTIFIER OUTPUT
D-C FILTER CAPACITOR(S) OPEN (REP. PROC. 1)
DIODE CR2 OR CR3 OPEN (REP. PROC. 2)
THYRISTOR CR4 OR CR5 OPEN (REP. PROC. 5)
(IF FURNISHED) HIGH-LOW VOLTAGE ALARM ACTIVATED
RECTIFIER OUTPUT VOLTAGE LOW
FLT/EQ CONTROLS REQUIRE ADJUSTMENT
EXCESSIVE LOAD AT RECTIFIER OUTPUT
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
THYRISTOR PULSE AMPLIFIER CIRCUIT CARD FAILURE (REP. PROC. 4)
THYRISTOR CR4 OR CR5 OPEN (REP. PROC. 5)
DIODES CR2 OR CR3 OPEN (REP. PROC. 2)
EXTENDED REFERENCE LEADS TO BATTERY OPEN (REP. PROC. 3)
RECTIFIER OUTPUT VOLTAGE HIGH
FLT/EQ CONTROLS ADJUSTED TOO HIGH
REGULATOR CIRCUIT CARD FAILURE
HIGH-LOW VOLTAGE ALARM CIRCUIT CONTROLS REQUIRE ADJUSTMENT
HIGH-LOW VOLTAGE ALARM CIRCUIT CARD FAILURE
HIGH VOLTAGE SHUTDOWN CIRCUITRY ACTIVATED
RECTIFIER OUTPUT VOLTAGE HIGH (NOTE 2)
FLT/EQ CONTROLS ADJUSTED TOO HIGH
REGULATOR CIRCUIT CARD FAILURE
D-C OUTPUT LEAD(S) OPEN
EXTERNAL CHARGING FUSE OPEN
HIGH VOLTAGE SHUTDOWN CIRCUIT REQUIRES ADJUSTMENT
HIGH VOLTAGE SHUTDOWN CIRCUIT CARD FAILURE
LOSS OF A-C INPUT POWER
A-C INPUT SWITCH S1 OPEN
REGULATOR POWER SUPPLY CIRCUIT CARD FAILURE
A-C INPUT FUSE F1 OR F2 OPEN
DIODES CR2 OR CR3 SHORTED (REP. PROC. 2)
THYRISTOR CR4 OR CR5 SHORTED (REP. PROC. 5)
A-C CONTROL FUSE F5 OPEN
CURRENT LIMIT CIRCUIT CARD FAILURE
THYRISTOR PULSE AMPLIFIER CIRCUIT CARD FAILURE
REGULATOR POWER SUPPLY CIRCUIT CARD FAILURE
(IF FURNISHED) CHARGE FAIL ALARM ACTIVATED
CHARGE FAIL ALARM CIRCUIT CARD FAILURE
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
THYRISTOR PULSE AMPLIFIER CIRCUIT CARD FAILURE (REP. PROC. 4)
REGULATOR POWER SUPPLY CIRCUIT CARD FAILURE
DIODES CR2 OR CR3 OPEN (REP. PROC. 2)
THYRISTOR CR4 OR CR5 OPEN (REP. PROC. 5)
EXTENDED REFERENCE LEADS TO BATTERY OPEN (REP. PROC. 3)
D-C OUTPUT FUSE F3 OPEN
FLT/EQ CONTROLS MISADJUSTED
EXCESSIVE LOAD AT RECTIFIER OUTPUT
CURRENT LIMIT CONTROL MISADJUSTED
CURRENT LIMITING CIRCUIT CARD FAILURE

NOTES :

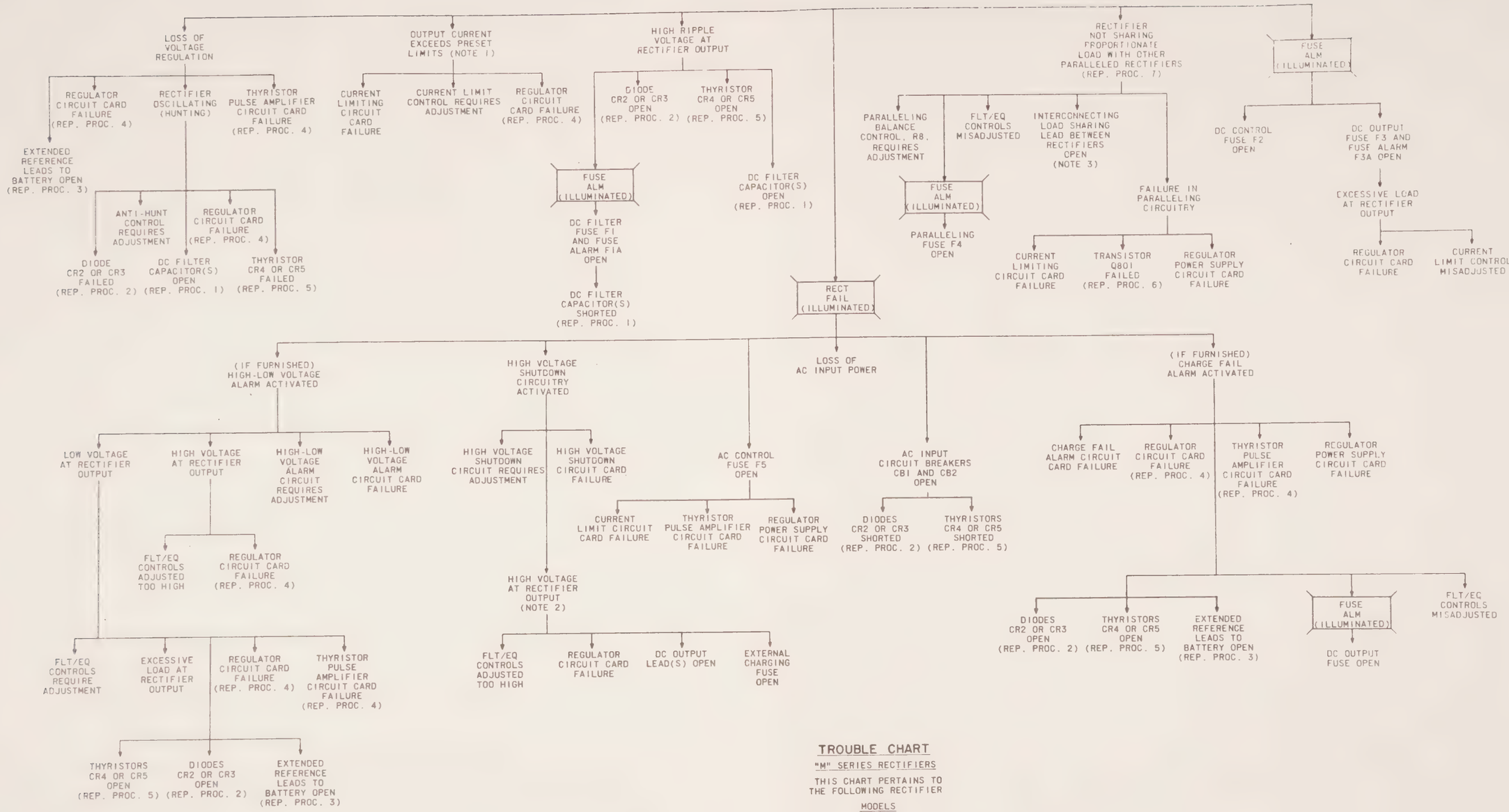
1. UNLESS OTHERWIRE SPECIFIED, CURRENT LIMIT IF FACTORY ADJUSTED TO 110% OF RATED OUTPUT.
2. UNLESS OTHERWISE SPECIFIED, HIGH VOLTAGE SHUTDOWN CIRCUIT IS FACTORY ADJUSTED TO SHUT DOWN RECTIFIER WHEN OUTPUT VOLTAGE EXCEEDS 60 VDC.

TROUBLE CHART

"M" SERIES RECTIFIERS

THIS CHART PERTAINS TO THE FOLLOWING RECTIFIER MODELS

M6F50
M12F50
M18F50
M25F50


LOSS OF VOLTAGE REGULATION
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
RECTIFIER OSCILLATING (HUNTING)
THYRISTOR PULSE AMPLIFIER CIRCUIT CARD FAILURE (REP. PROC. 4)
EXTENDED REFERENCE LEADS TO BATTERY OPEN (REP. PROC. 3)
ANTI-HUNT CONTROL REQUIRES ADJUSTMENT
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
DIODE CR2 OR CR3 FAILED (REP. PROC. 2)
DC FILTER CAPACITOR(S) OPEN (REP. PROC. 1)
THYRISTOR CR4 OR CR5 FAILED (REP. PROC. 5)
OUTPUT CURRENT EXCEEDS PRESET LIMITS (NOTE 1)
CURRENT LIMITING CIRCUIT CARD FAILURE
CURRENT LIMIT CONTROL REQUIRES ADJUSTMENT
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
HIGH RIPPLE VOLTAGE AT RECTIFIER OUTPUT
DIODE CR2 OR CR3 OPEN (REP. PROC. 2)
THYRISTOR CR4 OR CR5 OPEN (REP. PROC. 5)
FUSE ALM (ILLUMINATED)
DC FILTER FUSE F1 AND FUSE ALARM F1A OPEN
DC FILTER CAPACITOR(S) SHORTED (REP. PROC. 1)
DC FILTER CAPACITOR(S) OPEN (REP. PROC. 1)
RECTIFIER NOT SHARING PROPORTIONATE LOAD WITH OTHER PARALLELED RECTIFIERS (REP. PROC. 7)
PARALLELING BALANCE CONTROL, R8, REQUIRES ADJUSTMENT
FLT/EQ CONTROLS MISADJUSTED
INTERCONNECTING LOAD SHARING LEAD BETWEEN RECTIFIERS OPEN (NOTE 3)
FUSE ALM (ILLUMINATED)
PARALLELING FUSE F4 OPEN
FAILURE IN PARALLELING CIRCUITRY
CURRENT LIMITING CIRCUIT CARD FAILURE
TRANSISTOR Q801 FAILED (REP. PROC. 6)
REGULATOR POWER SUPPLY CIRCUIT CARD FAILURE
FUSE ALM (ILLUMINATED)
DC CONTROL FUSE F2 OPEN
DC OUTPUT FUSE F3 AND FUSE ALARM F3A OPEN
EXCESSIVE LOAD AT RECTIFIER OUTPUT
REGULATOR CIRCUIT CARD FAILURE
CURRENT LIMIT CONTROL MISADJUSTED
RECT FAIL (ILLUMINATED)
(IF FURNISHED) HIGH-LOW VOLTAGE ALARM ACTIVATED
LOW VOLTAGE AT RECTIFIER OUTPUT
HIGH VOLTAGE AT RECTIFIER OUTPUT
HIGH-LOW VOLTAGE ALARM CIRCUIT REQUIRES ADJUSTMENT
HIGH-LOW VOLTAGE ALARM CIRCUIT CARD FAILURE
FLT/EQ CONTROLS ADJUSTED TOO HIGH
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
FLT/EQ CONTROLS REQUIRE ADJUSTMENT
EXCESSIVE LOAD AT RECTIFIER OUTPUT
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
THYRISTOR PULSE AMPLIFIER CIRCUIT CARD FAILURE (REP. PROC. 4)
THYRISTORS CR4 OR CR5 OPEN (REP. PROC. 5)
DIODES CR2 OR CR3 OPEN (REP. PROC. 2)
EXTENDED REFERENCE LEADS TO BATTERY OPEN (REP. PROC. 3)
HIGH VOLTAGE SHUTDOWN CIRCUITRY ACTIVATED
HIGH VOLTAGE SHUTDOWN CIRCUIT REQUIRES ADJUSTMENT
HIGH VOLTAGE SHUTDOWN CIRCUIT CARD FAILURE
HIGH VOLTAGE AT RECTIFIER OUTPUT (NOTE 2)
FLT/EQ CONTROLS ADJUSTED TOO HIGH
REGULATOR CIRCUIT CARD FAILURE
DC OUTPUT LEAD(S) OPEN
EXTERNAL CHARGING FUSE OPEN
LOSS OF AC INPUT POWER
AC CONTROL FUSE F5 OPEN
CURRENT LIMIT CIRCUIT CARD FAILURE
THYRISTOR PULSE AMPLIFIER CIRCUIT CARD FAILURE
REGULATOR POWER SUPPLY CIRCUIT CARD FAILURE
AC INPUT CIRCUIT BREAKERS CB1 AND CB2 OPEN
DIODES CR2 OR CR3 SHORTED (REP. PROC. 2)
THYRISTORS CR4 OR CR5 SHORTED (REP. PROC. 5)
(IF FURNISHED) CHARGE FAIL ALARM ACTIVATED
CHARGE FAIL ALARM CIRCUIT CARD FAILURE
REGULATOR CIRCUIT CARD FAILURE (REP. PROC. 4)
THYRISTOR PULSE AMPLIFIER CIRCUIT CARD FAILURE (REP. PROC. 4)
REGULATOR POWER SUPPLY CIRCUIT CARD FAILURE
DIODES CR2 OR CR3 OPEN (REP. PROC. 2)
THYRISTORS CR4 OR CR5 OPEN (REP. PROC. 5)
EXTENDED REFERENCE LEADS TO BATTERY OPEN (REP. PROC. 3)
FUSE ALM (ILLUMINATED)
DC OUTPUT FUSE OPEN
FLT/EQ CONTROLS MISADJUSTED

NOTES:

1. UNLESS OTHERWISE SPECIFIED, CURRENT LIMIT IS FACTORY ADJUSTED TO 110% OF RATED OUTPUT.
2. UNLESS OTHERWISE SPECIFIED, HIGH VOLTAGE SHUTDOWN CIRCUIT IS FACTORY ADJUSTED TO SHUT DOWN RECTIFIER WHEN OUTPUT VOLTAGE EXCEEDS 60V DC.
3. IF TWO OR MORE RECTIFIERS EQUIPPED WITH SIMILAR LOAD SHARING CIRCUITRY ARE OPERATED IN PARALLEL, AN INTERCONNECTING LOAD SHARING LEAD (PAR) IS CONNECTED TO EACH FLOTROL RECTIFIER AT TB5, TERMINAL 3.

TROUBLE CHART

"M" SERIES RECTIFIERS

THIS CHART PERTAINS TO THE FOLLOWING RECTIFIER

MODELS

M30F50
M37F50
M50F50
M75F50
M100F50

RECTIFIER REPAIR PROCEDURES

These repair procedures are referenced by number on the associated trouble chart. When the trouble chart identifies a repair procedure, refer immediately to the numbered repair procedure for component test and circuit repair instructions.

The Repair Procedures given below are made with the unit under test disconnected from any power source, unless specifically stated otherwise in the test procedure.

Failed components may sometimes be found by a visual inspection of the Rectifier circuitry. Obvious signs of trouble such as loose connections, overheated, discolored, or burned components, or burned and melted wire insulation should be corrected and thoroughly checked before proceeding with more detailed test and repair procedures.

Since it may be possible to locate a failed component without disconnecting it from the circuit, check each suspected component in the unit before disconnecting any leads. If the trouble cannot be determined in this manner, disconnect the leads and recheck the component. Replace any failed components.

As an identification aid, semiconductor device outlines are provided so that identification of various semiconductor terminations may easily be made.

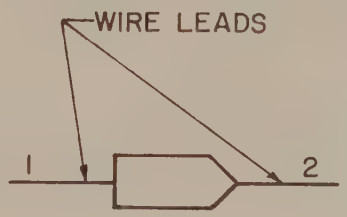
The test apparatus required to perform these repair procedures is given below:

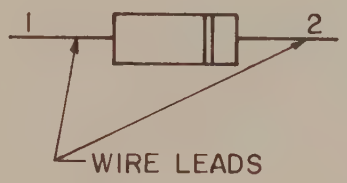
1	Multimeter, Triplett Model 630A, or equivalent
1	Oscilloscope, Hewlett-Packard Model 120B, or equivalent

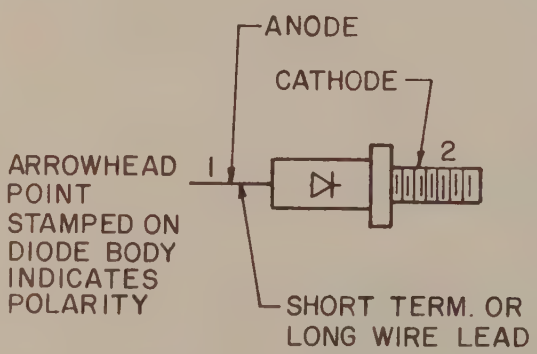
WARNING: Do not connect grounded test equipment to any live component. This could result in damage to the equipment under test. At the same time, a personnel shock hazard exists since the chassis and case of ungrounded test equipment "floats" at a potentially dangerous voltage level above ground. Servicing personnel must exercise caution that they do not contact the test equipment chassis or case and some grounded object at the same time when the test equipment is connected to an operating Rectifier.

SEMICONDUCTOR IDENTIFICATION OUTLINES

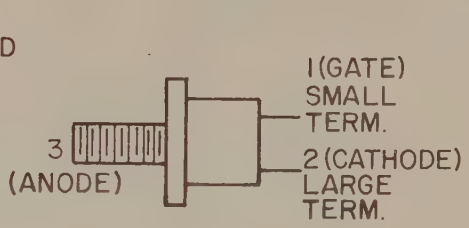
DIODES

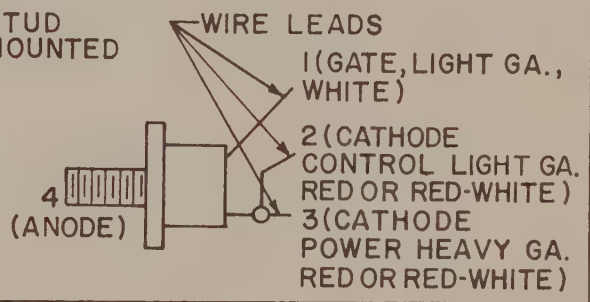




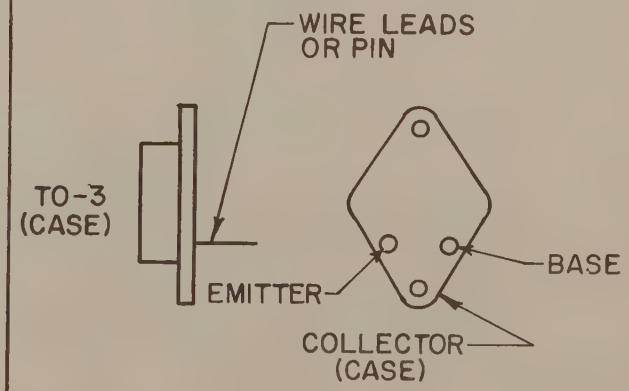


THYRISTORS



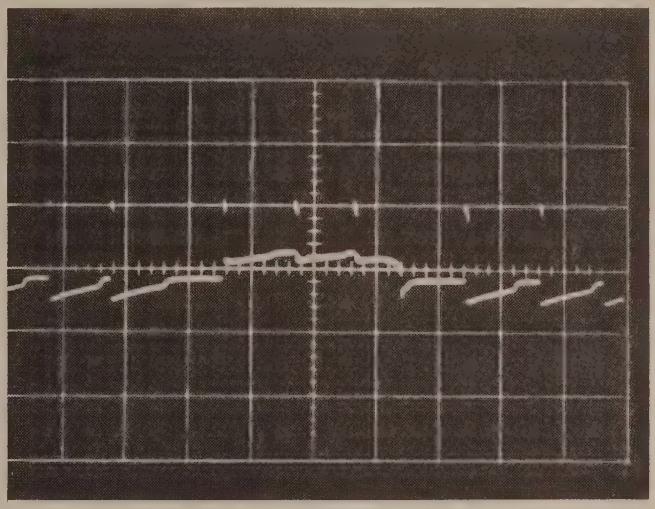

STUD MOUNTED
WIRE LEADS
1(GATE, LIGHT GA., WHITE)
2(CATHODE CONTROL LIGHT GA. RED OR RED-WHITE)
3(CATHODE POWER HEAVY GA. RED OR RED-WHITE)
4 (ANODE)

POWER TRANSISTOR



REPAIR PROCEDURE NO.	CHECK/REMEDY
1	Disconnect the capacitor(s) to be tested from the circuit. Use a capacitance bridge or capacitance tester to check any capacitor suspected of failure; however, if such a test instrument is unavailable, an ohmmeter may be used. Connect the negative ohmmeter lead to the positive terminal of the capacitor, and the positive ohmmeter lead to the negative terminal of the capacitor. Initially, the indicated resistance will be low, gradually increasing as the capacitor charges. Initial high resistance indicates an open capacitor, whereas continued low resistance indicates a leaky or shorted capacitor. Replace the capacitor(s) as required.
2	To check a diode, connect an ohmmeter across the diode leads, then reverse the ohmmeter connections. The ohmmeter should indicate high resistance in one direction and low resistance in the opposite direction. Low resistance or high resistance in both directions is an indication that the diode may have failed. If a diode failure is suspected, disconnect one of the leads and recheck the resistances. Replace the diode if it has failed.
3	Remove input power to the Rectifier by operating the AC input circuit breaker to the OFF position. CAUTION: AC power is still present within the Rectifier cabinet at terminal board TB1 and at the a-c input circuit breakers or switch. Open the Rectifier front cover and connect a DC voltmeter (or multimeter) to terminal board TB5. Terminal number 1 is positive (+), and terminal number 2 is negative (-).

REPAIR PROCEDURE NO.	CHECK/REMEDY
3 (Cont'd)	The voltmeter should indicate battery voltage (approximately 48VDC). If battery voltage is not present, this indicates that the reference leads are open between the Rectifier and the battery. Correct as required.
4	Remove a-c input to the Rectifier by operating the a-c input circuit breakers or switch to the OFF position. CAUTION: A-c power is still present within the Rectifier cabinet at terminal board TB1 and at the a-c input circuit breakers or switch. Open the Rectifier front cover, locate the power rectifier terminal board, and connect an oscilloscope probe across the gate (G) and cathode (K) terminations of CR4 and CR5 in turn to observe the thyristor firing pulses. Connect the common lead of the oscilloscope probe to the cathode (K) terminal for each thyristor. NOTE: Whenever disconnecting or connecting the oscilloscope leads to the terminals of either thyristor, insure that a-c input power to the Rectifier has been removed by operating the a-c input circuit breaker or switch to the OFF position. After all test connections have been made, insure that all test leads are insulated (or separated) from each other and from surrounding exposed connection points. Start the Rectifier, and observe the thyristor firing pulses on the oscilloscope.

REPAIR PROCEDURE NO.	CHECK/REMEDY
4 (Cont'd)	A signal similar to that shown below should appear across the G and K terminals of each thyristor.  The waveshape will be a pulse train of approximately 2 to 8 volts amplitude, with a variable time duration depending on the a-c input line voltage, the output voltage setting, and the load placed on the Rectifier. If the pulse signals are missing or irregular, replace either the Voltage Regulator Circuit Card (A1) or the Pulse Amplifier Circuit Card (A2), whichever card corrects the faulty condition.
5	Disconnect the cathode and gate leads of any thyristor to be checked. The cathode and gate leads may be disconnected at a terminal board, or the leads themselves may be disconnected from the circuit. If the thyristor has short, lug-type terminals, circuit wiring may be disconnected at these terminals. A thyristor tester should be used to check for an anode-to-cathode open or short. If such a tester is not available, the thyristor can be checked by the use of an ohmmeter. To check for an anode-to-cathode short, measure the

REPAIR PROCEDURE NO.	CHECK/REMEDY
5 (Cont'd)	resistance from anode-to-cathode; a low resistance indicates an anode-to-cathode short. To check for an open or shorted thyristor gate, measure the resistance of the gate-to-cathode in both directions. A reading of zero ohms in both directions indicates a shorted thyristor. A reading of infinity in both directions indicates an open thyristor. Replace the thyristor as required.
6	Open the Rectifier front cover and locate transistor Q801 which is mounted on the left side of the upper-front panel of control unit A8. WARNING: Insure that a-c input power to the Rectifier has been removed by operating the a-c input circuit breakers CB1 and CB2 to the OFF position. Remove relay K803 from its socket and set it aside. This relay will be re-installed when this test and repair procedure is completed. Loosen and remove the two threaded fasteners passing through the flanges of the transistor case, and gently pull the transistor from its socket, being careful not to damage the mica insulator on the bottom of the case. Set a multimeter on the RX 10 ohm range, and connect the meter probes between the emitter and collector terminations of the transistor, then reverse the meter connections. The meter should indicate a high resistance in both directions. If the meter indicates a low resistance or zero ohms in either direction, the transistor has failed, and requires replacement. Connect the meter probes between the emitter and base pins of the transistor, then reverse the meter connections. The meter should indicate a low resistance in one direction and a

<table>
<tr><th>REPAIR PROCEDURE NO.</th><th>CHECK/REMEDY</th></tr>
<tr><td>6 (Cont'd)</td><td>high resistance in the opposite direction. If the meter indicates zero ohms or an extremely high resistance in both directions, the transistor has failed and requires replacement.

Connect the meter probes between the base and collector terminations of the transistor, then reverse the connections. The meter should indicate a low resistance in one direction, and a high resistance in the opposite direction. If the meter indicates zero ohms or an extremely high resistance in both directions, the transistor has failed and requires replacement.

When replacing this power transistor, apply a thin coating of thermal joint compound to the mounting surface of the transistor case, and to the mica insulating washer. The thermal compound provides both efficient heat transfer and improved insulation between the transistor case and its mounting plate.

Re-install the transistor in its socket, and secure it in place with the two threaded fasteners removed earlier in this repair procedure. Re-install relay K803 in its socket.</td></tr>
<tr><td>7</td><td>To determine if the load sharing circuitry is operating correctly, connect a d-c voltmeter (or multimeter) to the output of the load sharing circuit, terminals number 2 (-) and number 3 (+) of TB5. This circuit provides a linear output voltage with respect to Rectifier output current, and circuit operation may be checked under the load conditions shown below:

<table>
<tr><th>Percentage of Rated Rectifier Output Current</th><th>Load Sharing Output Voltage (VDC)</th></tr>
<tr><td>0</td><td>Less than 2.5</td></tr>
<tr><td>100</td><td>8</td></tr>
</table>
</td></tr>
</table>

REPAIR PROCEDURE NO.	CHECK/REMEDY
7 (Cont'd)	If paralleled Rectifiers with similar load sharing circuits installed do not proportionately share a load, insure that all output voltage controls are adjusted so that all Rectifier outputs are at the same voltage level. Similarly, all load sharing circuits must be correctly adjusted. Refer to appropriate Rectifier instruction manuals for correct procedures for adjustment of output voltage, and adjustment of load sharing circuitry. If, after attempting the required adjustments, the load sharing circuit output voltage is missing or irregular, check the load sharing control transistor, Q801. Refer to repair procedure 6. If transistor Q801 is not faulty, it is recommended that the control unit assembly, A8, be replaced.

LORAIN PRODUCTS CORPORATION
Lorain, Ohio, U.S.A.

LORAIN PRODUCTS (CANADA) LTD.
St. Thomas, Ontario, Canada

February 6, 1974

Form 3180

Printed in U.S.A.

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RECOMMENDED SPARE PARTS LIST
LORAIN MODEL M100F50 FLOTROL RECTIFIER
SPEC. NO. 5451-001

This Recommended Spare Parts List is arranged alphabetically by part name. Spare parts are not usually required if adequate standby equipment is available and if the LORAIN equipment is installed at an accessible location so that parts can readily be obtained from Lorain Products stock. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate. If two asterisks (**) appear, refer to the Recommended Spare Parts List for that accessory.

LPC Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depot Level
ACCESSORIES				
2544-452	Equalize Timer	-	1	1
4826-035	External Filter Assembly	-	**	**
4846-080	Remote Control Relay Assembly	-	**	**
4846-092	Charge Failure Alarm Relay Assembly	-	**	**
4863-114	High/Low Voltage Alarm Assembly	-	**	**
ASSEMBLIES				
4332-002	Component PW Board	-	1	1
4334-005	Circuit Card PW Board	-	1	1
4336-012	Resistor/Diode PW Board	-	1	1
4336-014	Circuit Card PW Board	-	1	1
4338-006	Circuit Card PW Board	-	1	1
4863-725	High Voltage Shutdown PW Board	-	1	1
4865-713	Circuit Card PW Board	-	1	1
CAPACITORS				
2715-250	0.1UF 600 Volt DC	-	1	1
2715-262	0.5UF 600 Volt DC	-	1	1
2715-284	2UF 300 Volt DC	-	1	1
2731-185	500UF 25 Volt, Electrolytic	-	-	-
2731-264	2000UF 6 Volt, Electrolytic	-	-	-
2731-324	8500UF 75 Volt, Electrolytic	-	-	-
CIRCUIT BREAKERS				
2567-089	50 Amp 120/240 Volt AC	-	1	1
2567-099	100 Amp 120/240 Volt AC	-	1	1

RECOMMENDED SPARE PARTS LIST
LORAIN MODEL M100F50 FLOTROL RECTIFIER
SPEC. NO. 5451-001

LPC Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depo Leve
FUSES				
2484-348	45 Amp, Slow Blowing	3	3	3
2484-535	60 Amp 125 Volt	3	3	3
2486-202	0.25 Amp, Alarm	3	3	3
2486-203	0.25 Amp, Alarm	4	4	4
2486-208	1.33 Amp, Alarm	4	4	4
INDICATOR LAMPS				
2581-213	48 Volt, Filament	1	2	4
MAGNETIC UNITS				
4411-033	DC Filter Inductor	-	-	1
4431-037	DC Filter Inductor	-	-	1
4431-508	DC Filter Inductor	-	-	1
4465-506	Current Transformer	-	-	1
4466-009	Power Transformer	-	-	1
4485-502	Auxiliary Transformer	-	-	1
4532-507	Saturable Current Transductor	-	-	1
METERS				
2924-676	0-150 Ammeter, DC	-	-	1
2944-671	0-80 Voltmeter, DC	-	-	1
RELAYS				
2543-137	12 Volt DC	-	1	1
2543-138	12 Volt DC, Gold Contact	-	1	1

RECOMMENDED SPARE PARTS LIST
LORAIN MODEL M100F50 FLOTROL RECTIFIER
SPEC. NO. 5451-001

LPC Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depot Level
RESISTORS				
2615-245	180 Ohm 0.5 Watt, Fixed	-	1	1
2652-335	1K Ohm 10 Watt, Fixed	-	1	1
2656-313	100 Ohm 5 Watt, Fixed	-	1	1
2683-235	50 Ohm 2 Watt, Potentiometer	-	1	1
2683-248	250 Ohm 2 Watt, Potentiometer	-	1	1
2683-255	500 Ohm 2 Watt, Potentiometer	-	1	1
2982-713	150 Amp, External Shunt	-	-	1
SEMICONDUCTORS				
2416-221	Surge Suppressor	-	1	1
2812-310	1N4818, Silicon Diode	-	1	1
2814-331	1N3265, Silicon Diode	-	1	1
2814-332	1N3265R, Silicon Diode	-	1	1
2842-150	2N3055, Transistor	-	2	2
2863-121	150 Amp 300 Volt, Thyristor	-	2	2
SWITCHES				
2513-321	Toggle, DPDT	-	-	1
MISCELLANEOUS				
2486-310	Designation Pin, Violet	-	-	1
2486-311	Designation Pin, Violet-White	-	-	1
2486-322	Designation Pin, White	-	-	1
2488-130	Fuseholder	-	-	1
2488-224	Fuse Block	-	-	1
2584-113	Lampholder	-	-	1
2584-636	Cap, Lens, Red	-	-	1
2584-638	Cap, Lens, White	-	-	1

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Lorain, Ohio, U.S.A.

LORAIN PRODUCTS (CANADA) LTD.
St. Thomas, Ontario, Canada

RECOMMENDED SPARE PARTS LIST
LORAIN 4826-035 EXTERNAL FILTER ASSEMBLY

This Recommended Spare Parts List is arranged alphabetically by part name. Spare parts are not usually required if adequate standby equipment is available and if the LORAIN equipment is installed at an accessible location so that parts can readily be obtained from Lorain Products stock. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate.

LPC Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depot Level
CAPACITORS				
2731-324	8500UF 75 Volt, Electrolytic	-	-	-
FUSES				
2484-524	25 Amp, Cartridge	4	4	4
RESISTORS				
2656-708	50 Ohm 100 Watt, Fixed	-	1	1

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RECOMMENDED SPARE PARTS LIST
LORAIN 4846-080 REMOTE CONTROL RELAY ASSEMBLY

This Recommended Spare Parts List is arranged alphabetically by part name. Spare parts are not usually required if adequate standby equipment is available and if the LORAIN equipment is installed at an accessible location so that parts can readily be obtained from Lorain Products stock. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate.

LPC Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depot Level
CONTACTORS				
2561-035	200 Amp 50 Volt DC	-	-	1
RESISTORS				
2652-322	200 Ohm 10 Watt, Fixed	-	1	1

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RECOMMENDED SPARE PARTS LIST
LORAIN 4846-092 CHARGE FAILURE ALARM RELAY ASSEMBLY

This Recommended Spare Parts List is arranged alphabetically by part name. Spare parts are not usually required if adequate standby equipment is available and if the LORAIN equipment is installed at an accessible location so that parts can readily be obtained from Lorain Products stock. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate.

LPC Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depot Level
ASSEMBLIES				
4337-012	Component PW Board	-	1	1
RELAYS				
2543-137	12 Volt DC	-	1	1

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RECOMMENDED SPARE PARTS LIST
LORAIN 4863-114 HIGH/LOW VOLTAGE ALARM ASSEMBLY

This Recommended Spare Parts List is arranged alphabetically by part name. Spare parts are not usually required if adequate standby equipment is available and if the LORAIN equipment is installed at an accessible location so that parts can readily be obtained from Lorain Products stock. When ordering parts, please furnish equipment Model No., Spec. No., and Serial No. as given on the equipment nameplate. If two asterisks (**) appear, refer to the Recommended Spare Parts List for that accessory.

LPC Part Number	Description	Quantity Recm. Spares Minimum Level	On-Site Level	Depot Level
ASSEMBLIES				
4337-609	Hi-Low Voltage Alarm Circuit	-	1	1
RELAYS				
2543-797	48 Volt DC	-	1	1

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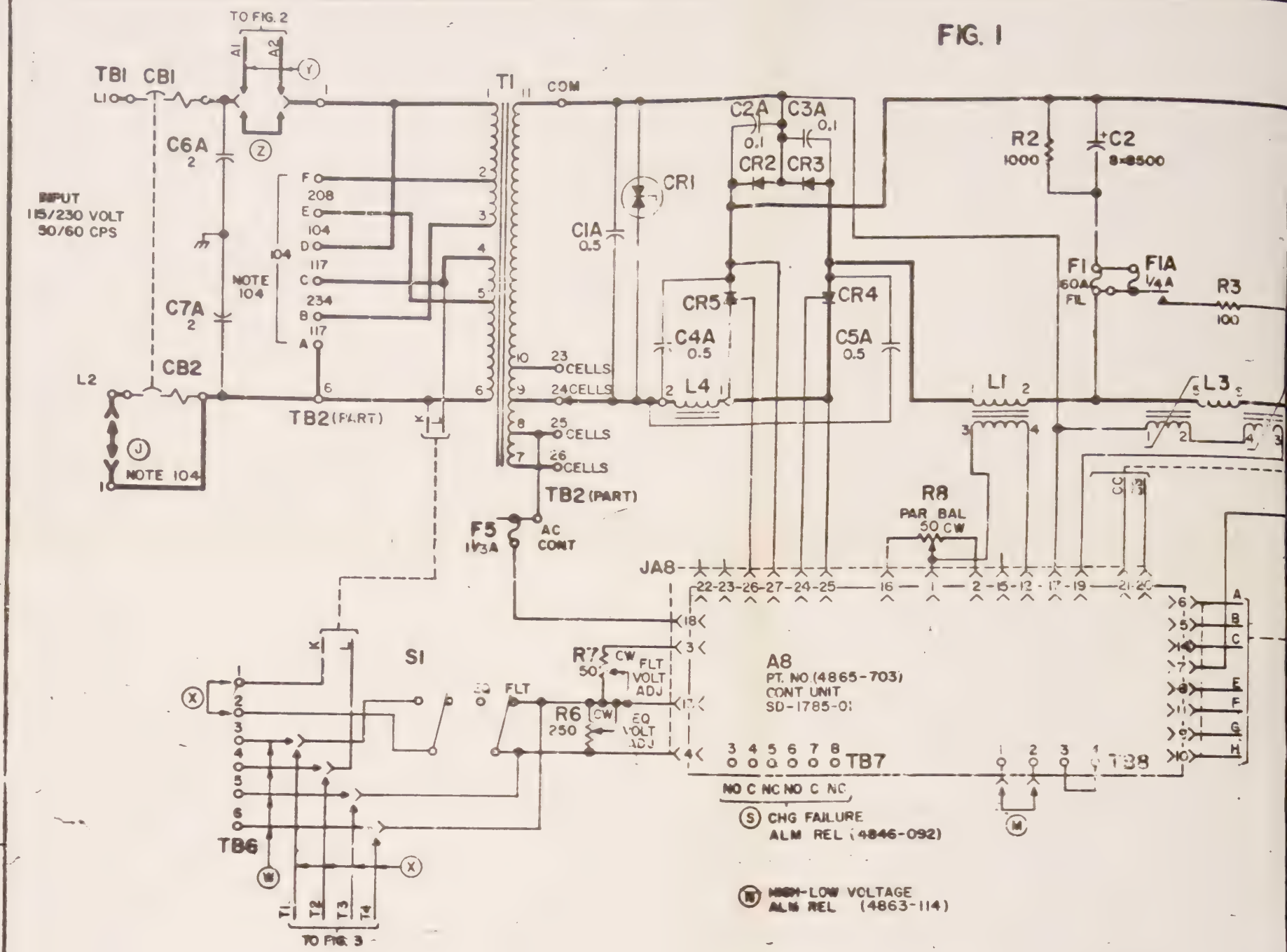
FIG. 1



INFORMATION NOTES:

301 EXCEPT AS NOTED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES IN MICROFARADS.

302 CODES WITHIN PARENTHESES, AS (2544-452) REPRESENT LORAN PART NO'S.

303 SEE WIRING DIAGRAM T-5451-001 FOR L.P.C. PT. NO. OF COMPONENTS.

304 HIGHEST REF. DESIG. USED ON THIS DWG

RES.	CAP.
R53	C7A
NOT USED	
R1	C1
R9-52	C4-7

305 UNLESS OTHERWISE SPECIFIED, THE FOLLOWING APP. OR WIRING IS FURNISHED: Z, W, R

CIRCUIT NOTES

104 LINE VOLTAGE CONNECTIONS

INPUT VOLTAGE	CONNECT	OPTION J
104	A TO F D TO E	REQ
117	A TO B C TO D	
208	E TO F	NOT REQ
234	B TO C	

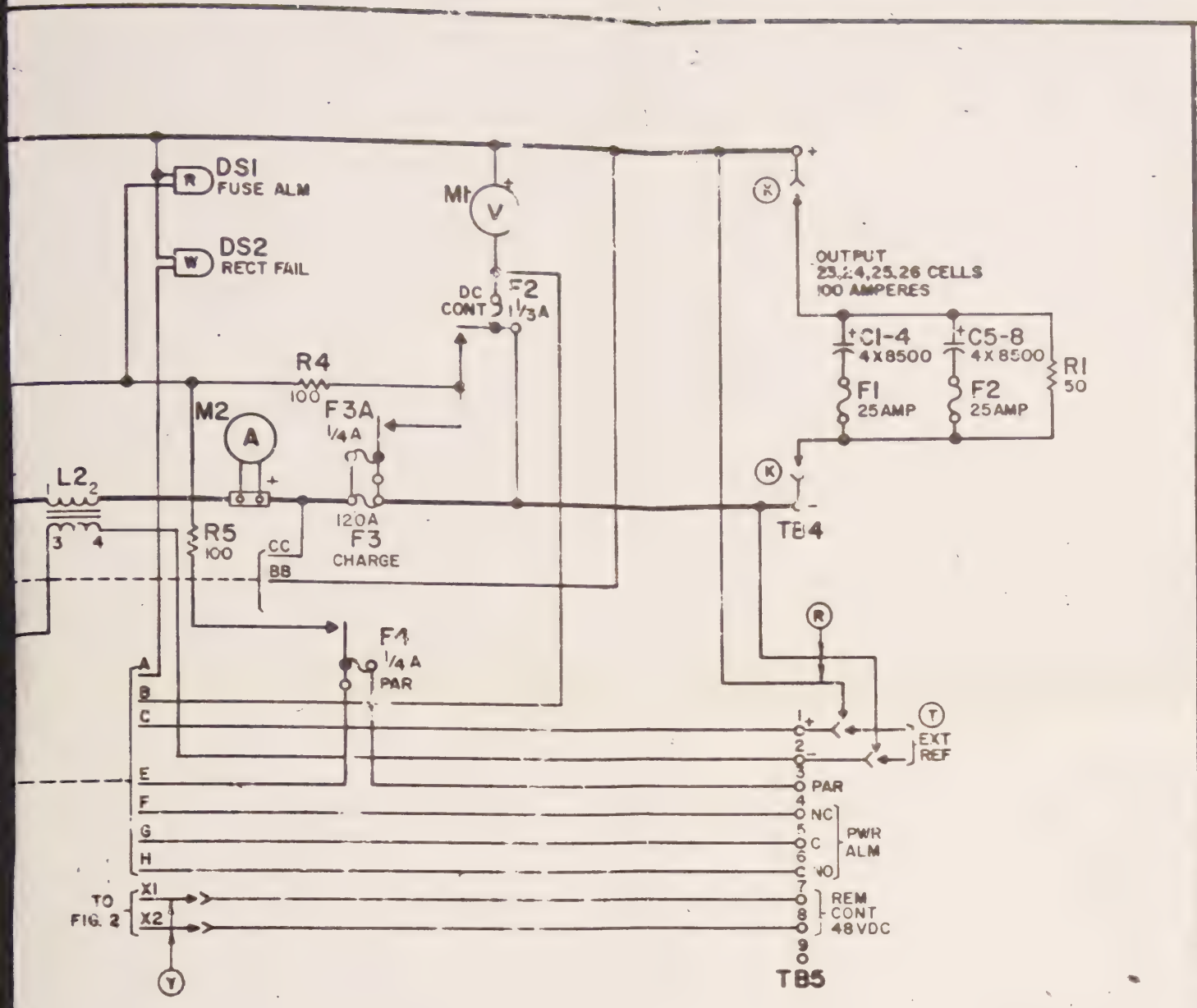
EQUIPMENT NOTES:

202 FOR USE AS A BATTERY ELIMINATOR CONNECT EXTERNAL FILTER (L. P. C. PT. NO. 4826-035) "K" OPTION, TO OUTPUT TERMINALS.

OPTION INDEX

OPTION		APP OR WRG	LOCATION	OPTION	APP OR WRG	
REMOTE START	REQ'D	Y	FIG. 1, FIG. 2	OPERATION WITHOUT BATTERY	M	F
	NOT REQ'D	Z	FIG. 1	CHG FAILURE ALM REL	S	F
EQ TIMER	REQ'D	X	FIG. 1, FIG. 3			
	NOT REQ'D	W	FIG. 1			
EXT REF	REQ'D	T	FIG. 1	HIGH-LOW VOLT ALM REL	N	F
	NOT REQ'D	U	FIG. 1			

LP429



DWG REV	CHG NO	DATE	DRAWN BY	APP BY
1 M				
2 M	11900	9-10-64	C Pratt	
3	12975	1-16-67 M		
4	13628	2-9-66		
5	13656	3-10-65		
6	13695	6-2-65 5-12-65 5-18-65	C Pratt G Fischer	
7	14419	6-17-65 C-17-65	C Pratt G. Fischer	
8	15440	12-6-65 12-6-65		
9	15687	5-18-66 5-18-66	CHGD R9 TO R53 ON REMOTE CONTROL	
10	15265 15238	8-10-66	"Q" OPTION REMOVED F3 WAS 150A	
11	17345,	1-16-67	RLC1 REMOVED, C1A-C7A, L4 ADDED.	
12	18423	5-16-69	"K" OPTION ADDED.	
13	19441	11-17-69	V OPTION REMOVED	
14	1831207	10-1-71	NOTE 201 REMOVED	
15	1832537	1-28-73	L2 CHANGED SEC WDG ADDED WAS SD-1738-05	

FIG. 2

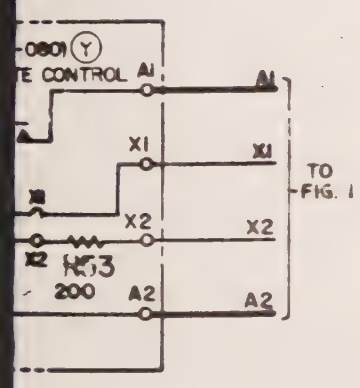
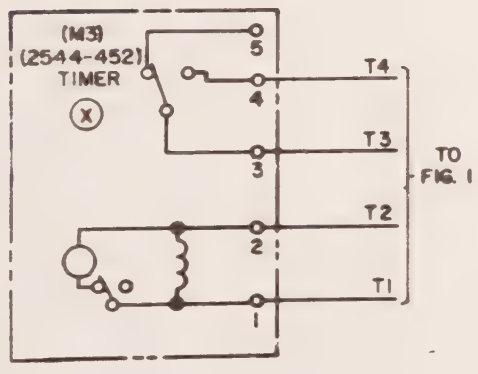


FIG. 3



LOCATION
G. 1 & SD-1785-01
F 1 & SD-1785-01
G. 1 & SD-1785-01

OPTION		APP OR WRG	LOCATION
LINE VOLTAGE	115 V	J	FIG. 1
	230 V	NONE	
OPERATION WITHOUT BATTERY AND EXTERNAL FILTER		K, M	FIG. 1 SD-5451-001 FIG. 1 SD-1785-01

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SD-1738-05

ISSUE 1

SCHEMATIC DIAGRAM
FOR
M100F50
SPEC. 5451-001

REPRO BY	DATE 7-30-64
CHECKED BY	DATE 7-31-64
APPROVED BY MFG	DATE
APPROVED BY	DATE 8-7-64
RATING	STANDARD

SD-5451-001

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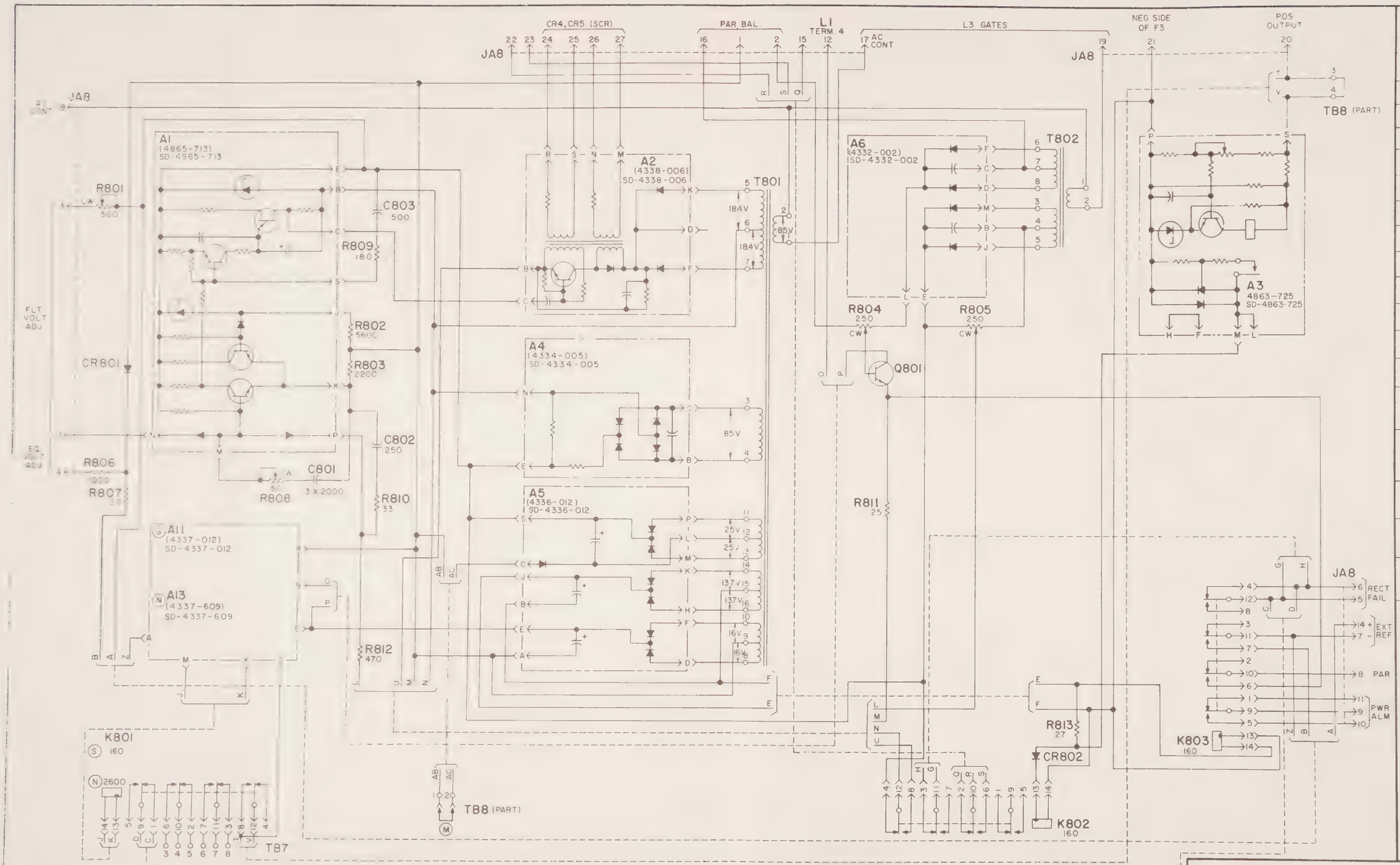

2	2249	-64		
3M	12298	9 23 64		
4	12688	2-11-64		
5	12588	2-8-65		
6	13647	3-8-65		
7	14419	6-17-65		
8	14454	7-19-65		U S P 20 67
9	14473	8-2-65		
10	14675	9-20-65	ROC	
11	15477	1-31-66		
12	15671	3-3-66		
13	15265	8-10-66	"Q" OPTION REMOVED	
14	15291	9-8-66	CR802 ADDED	
15	17768	7-28-67	PINS 24,25, 26,27 SCR REF DESIG CORRECTED	
16	18177	1-31-68 2-2-68	A3 PT NO WAS 4337-013 SD-1794-01. R814 REM.	
17	18422	9-11-69	A3 POT. WIRING CORRECTED	
18	19441	1-2-70	"V" OPTION REMOVED	
19	19800	1-27-70	TEST VOLTAGES ADDED	

INFORMATION NOTES

101. EXCEPT AS NOTED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS.
102. SEE WIRING DIAGRAM T-4865-703 FOR L.P.C. PT NO. OF COMPONENTS.
103. HIGHEST REF DESIG USED ON THIS DWG.

RES	CAP
R814	C803
NOT USED	
UP TO R800	UP TO C800

104 ALL VOLTAGES ARE AC VOLTAGES AND ARE TAKEN WITH 230VAC IN ON THE 234V TAP.

OPTION INDEX

OPTION	APP OR WRG
CHG FAILURE ALM RELAY	S
OPERATION WITHOUT BATTERY	M

OPTION	APP OR WRG
HIGH-LOW VOLT ALM REL	N

SPANISH VERSION AVAILABLE

WAS SD-1785-0.

SCHEMATIC DIAGRAM
CONTROL UNIT A8
"M" SERIES SILICON FLOTROLS
48V
30, 37, 50, 75, 100 AMPS
(4865-703)

DRAWN BY: [illegible] DATE 6-18-64
CHECKED BY: [illegible] DATE
ENGINEER: [illegible] DATE 6-24-64
APPROVED BY: [illegible] DATE 6-24-64
APPROVED BY: [illegible] DATE 6/29/64
R&I NO. STANDARD

SD-4865-703

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DW SIZE D

SHEET 1 OF 1

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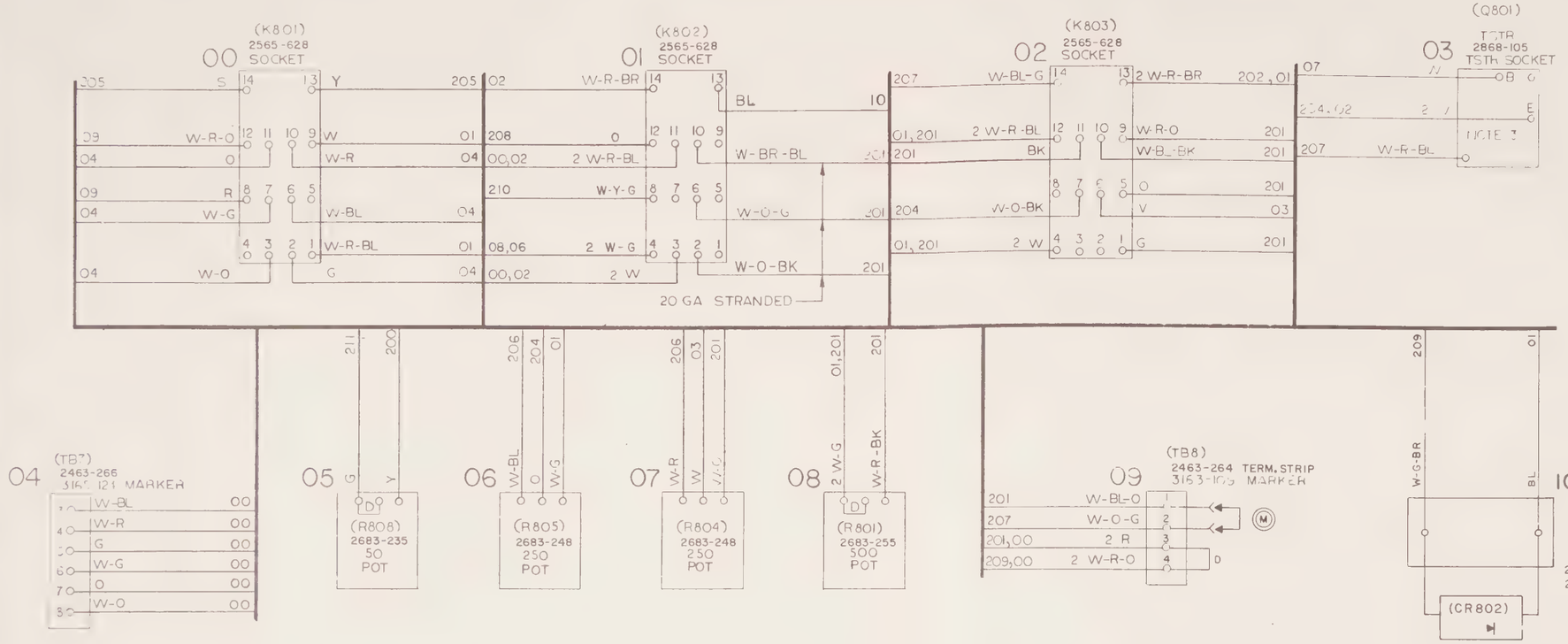

"Q" OPTION REMOVED

CR802 AT LOC 101 AND NOTE 5 ADDED.

10 18177 2-15-68 R814 REMOVED, AT LOC 209

11 18694 10-11-68 Y WIRE LOC 205 WAS W-BK

12 1830169 10-8-70 3876-319 WAS 2475-747 ON SH 2

13 1832356 LOC. 10 ADDED 2565-628 WAS 2565-621 LOC. 01

MANUFACTURING NOTES:

1. ALL WIRES SHALL BE 24 GA STRANDED UNLESS OTHERWISE SPECIFIED
2. "D"-SEPARATE WIRE NOT PART OF WIRING HARNESS
3. MOUNTED WITH MICA INSULATOR OR EQUIVALENT
4. UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS

SD-DRAWING ISSUES AND T-DRAWING ISSUES AS FOLLOWS

SD-DRAWING ISSUES																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	19	19

T-DRAWING ISSUES																				
1	1	1	1	2	3	4	4	5	5	6	7	8	9	10	11	11	11	11	12	13

PIGTAIL COMPONENT INFORMATION			
REF DESIG	L.P.C PT. NO.	VALUE	LOC
CR802	2812-310		01

WAS T-1785-01

ISSUE 13

WIRING DIAGRAM FOR CONTROL UNIT

4865-703

DRAWN BY A. MACIEJCI DATE 8-15-64

DSGN BY JAKUBOWSKI DATE 8-15-64

APPROVED BY DATE

APPROVED BY DATE

RATING STANDARD

T-4865-703

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DWG SIZE D

SHEET 1 OF 2

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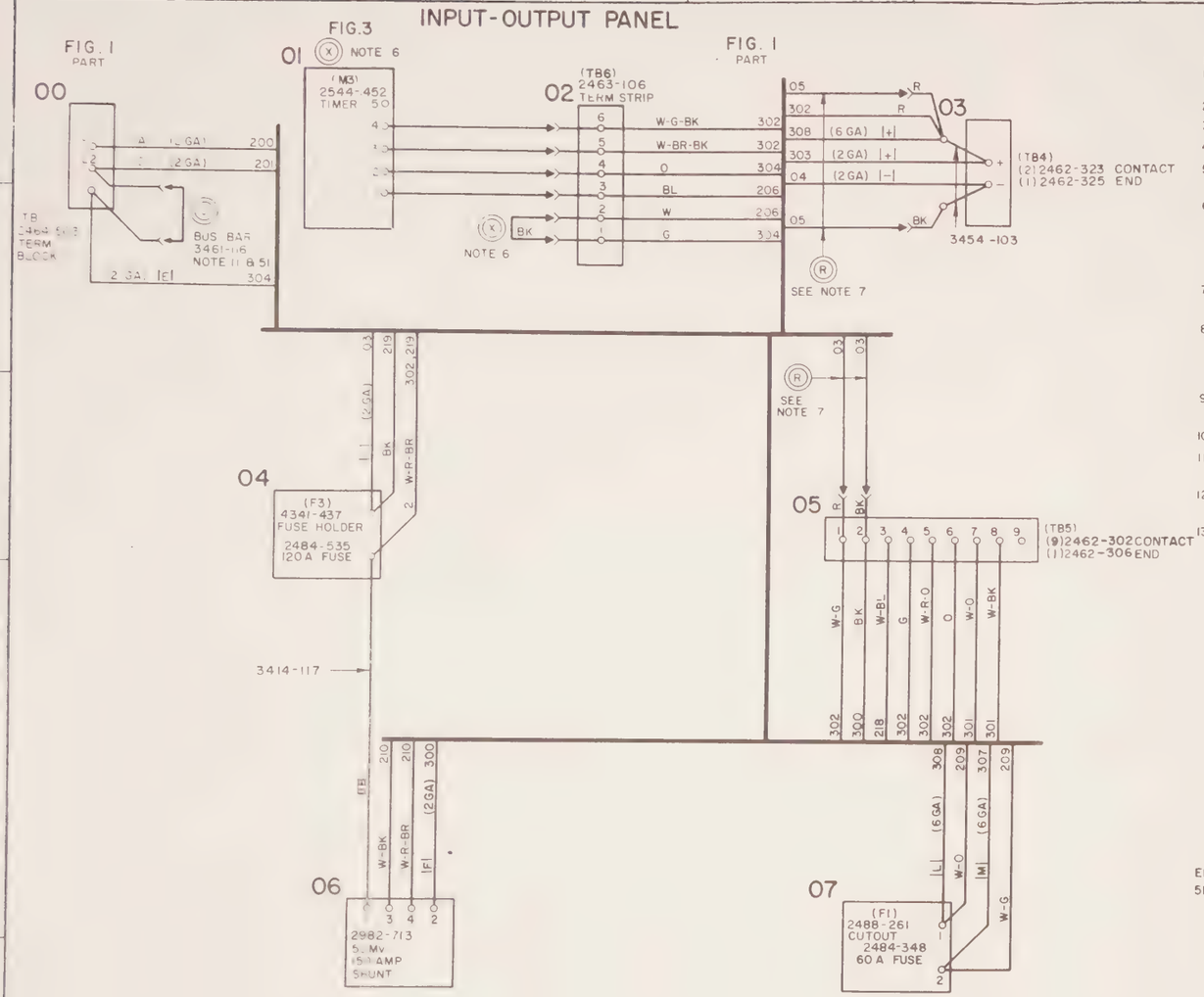
LP429

INPUT-OUTPUT PANEL



MANUFACTURING NOTES

1 ALL WIRES SHALL BE 20GA STRANDED UNLESS OTHERWISE SPECIFIED

2 BI-TERMINAL NEAREST MOUNTING SURFACE

3 PT-LEADS FURNISHED WITH COMPONENTS.

4 (2 TW)-TWO WIRES SHALL BE TWISTED TOGETHER.

5 UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS.

6 IF EQ TIMER M3 ("X" OPTION) IS REQUIRED, REMOVED THE FOLLOWING WIRES FROM TB6 AND CONNECT TO M3 TERMINALS; BL TO TERM 1, O TO TERM 2, W-BR-BK TO TERM 3, AND W-G-BK TO TERM 4, CONNECT A JUMPER ACROSS TERMINALS 1 AND 2 ON TB6

7 WHEN EXTENDED REFERENCE IS NOT SPECIFIED, CONNECT TERMINALS 1 AND 2 OF TB5 TO + AND − OF TB4 AS SHOWN

8 WHEN REMOTE CONTROL RELAY, "Y" OPTION, IS NOT FURNISHED, BOLT NO. 2 GAUGE LEADS TOGETHER WITH 3/8" HDW, "Z" OPTION, AND INSULATE WITH SLEEVING; INSULATE W-O AND W-BK WIRES WITH SLEEVING AND TIE TO NO. 2 GAUGE SLEEVED WIRES.

9 WIRES TO BE CONNECTED TO BACKSIDE OF STUDS ON POWER TRANSFORMER TERMINAL PANEL

10 D- INDICATES LEAD IS A JUMPER.

11 BUS BAR, L.P.C. PT. NO. 3461-116, SHALL BE SUPPLIED WITH EACH FLOTROL.

12 ATTACH L.P.C. PT. NO. 2568-806 HANDLE TIE TO CB1 AND CB2 AFTER THEY ARE INSTALLED IN PANEL

13 BB- INDICATES BUS BAR

ENGINEERING NOTES:

51 FOR 115V INPUT, "J" OPTION, CONNECT BUS BAR, L.P.C. PT. NO. 3461-116, BETWEEN "L2" AND NO.1 TERMINALS ON TB1, CONNECT SERVICE WITH NEUT. SIDE TO "L2" TERMINAL AND OTHER SIDE TO TERMINAL "L1". FOR 230V INPUT, REMOVE BUS BAR FROM "L2" AND NO.1 TERMINALS OF TB1, CONNECT SERVICE TO "L1" AND "L2" TERMINALS. FOLLOW TABLE ON TRANSFORMER T1 FOR 115 OR 230 VOLT CONNECTION.

REVISION NOTES					
ISSUE 2					
ISSUE 3: ERRORS CORRECTED ON SH 3 FOS 02 AND 04 AND SH 2 POS 18,15					
ISSUE 5: SLATE WIRE REMOVE FROM 103 NEG TO 302 TERM 15 TB7 DESIG. CHGD	2 M	1900 REDRAWN	9-10-64 9-10-64	A MUCHA RFF	AFT 9-22-64
ISSUE 6: C4 REMOVED, LOCATION 03, SH 2.	3	12975	1-14-64		
ISSUE 7: F3 PT NO. AND FUSE HLR CHG'D ON SH 1 LOC 04, 4341-437 WAS 1185SAI 2484-537 WAS 245M	4	13630	2-9-65		
ISSUE 8: ADDED NOTES 2,3,4,5,6,11,12,13 AND 51. CORRECTED WIRING AT LOC 204, 205, AND 214 CORRECTED INSTALLERS NOTE 2, ADDED NOTE 7, AND CORRECTED TERMINATIONS OF TB7	5	13656	3-10-65		
	6	14419	6-16-65		
ISSUE 9: F3 WAS A 150 AMP FUSE, LOC 104, CORRECTED TABLE "A" ON INSTALLERS SHEET AND TB1 WAS A 479LB TERM. BLOCK, LOC 100. ADDED "Z" OPTION TO LOC 301.	7	14484	8-18-65	G SABATER 8-18-65	
	8	15687	5-25-66 6-3-66		
ISSUE 10: CORR TABLE "A" INPUT AND OUTPUT LUG CAPACITY ON SHEET 4	9	15238	8-11-66		
	10	17164	12-21-66		
ISSUE 11: R-F SUPPRESSION ADDED AT LOC 303, 304, 306-1	11	17345	1-17-67		
ISSUE 12: 227 WK REPLACED BY 314 WK LOCATION 303	12	17386	3-13-67		
ISSUE 13: LOC 305 REMOVED.	13	17793			
ISSUE 14: 4826-035, SH 4, WAS "M" OPTION	14	18423	5-15-69		
ISSUE 15: W-BR-R WIRE AT F3A WAS W-R-BK IN ERROR	15	19554	10-2-69		
ISSUE 16: "V" OPTION OMITTED	16	19441	11-11-69		
ISSUE 17: SHEET 4 DELETED REPLACED BY PD	17	19915	4-30-70		
ISSUE 18: C6A, 7A PT NO. WAS 2715-285	18	1830545	2-17-71		
ISSUE 19: L2 WAS 4411-516 LOC 300 WIRING CHANGED LOC 105, 300 AND 302 WAS T-1738-05	19	1832537	1-29-73		
ISSUE 20: PT NUMBERS LOC 103 AND 105 CORRECTED	20	1833537	10-18-73		

T-1738-05

SD-DRAWING ISSUES AND T-DRAWING ISSUES AS FOLLOWS																					
SD-DRAWING ISSUES																					
1	2	3	4	5	6	7	7	8	9	10	10	11	11	11	12	12	13	13	13	14	15	15	
T-DRAWING ISSUES																					
	2	3	4	5	5	6	7	7	8	9	10	11	12	13	14	15	16	17	18	18	19	20	

WIRING DIAGRAM

FLOTROL RECTIFIER

MODEL M100F50

SPEC 5451-001

DRAWN BY H. WRIGHT DATE 7-17-64
CHECKED BY DATE
APPROVED BY R. MAGNER DATE 8-12-64
APPROVED BY J. MITCHELL DATE 8-12-64
STANDARD

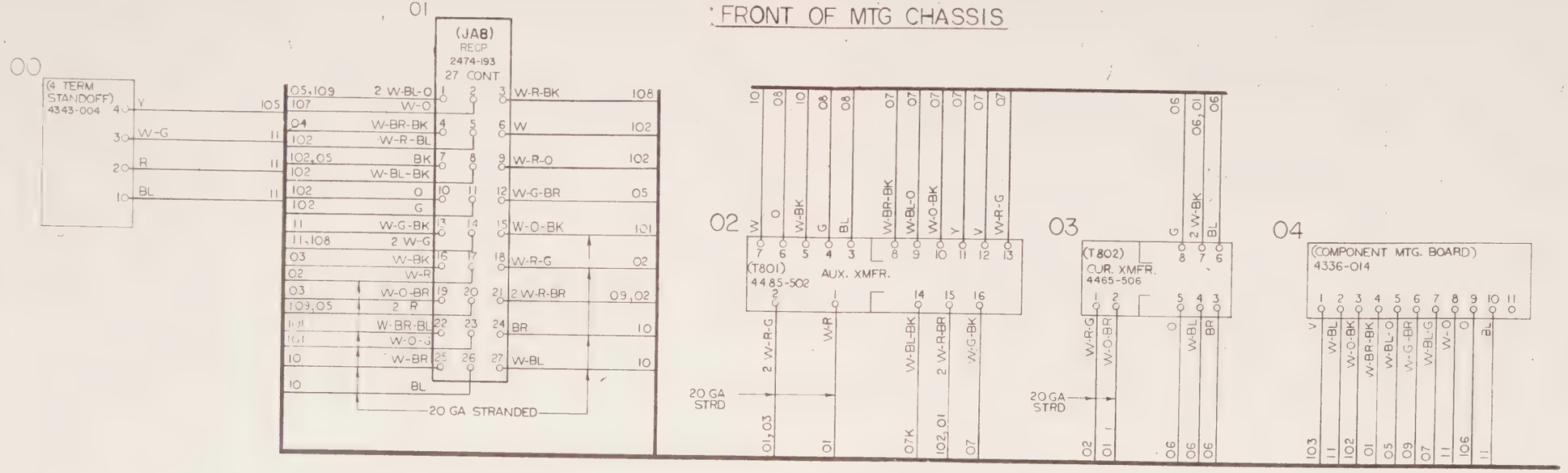
T-5451-001

LORAIN PRODUCTS CORPORATION
LORAIN, OHIO
LORAIN PRODUCTS (CANADA) LTD., ST. THOMAS ONTARIO

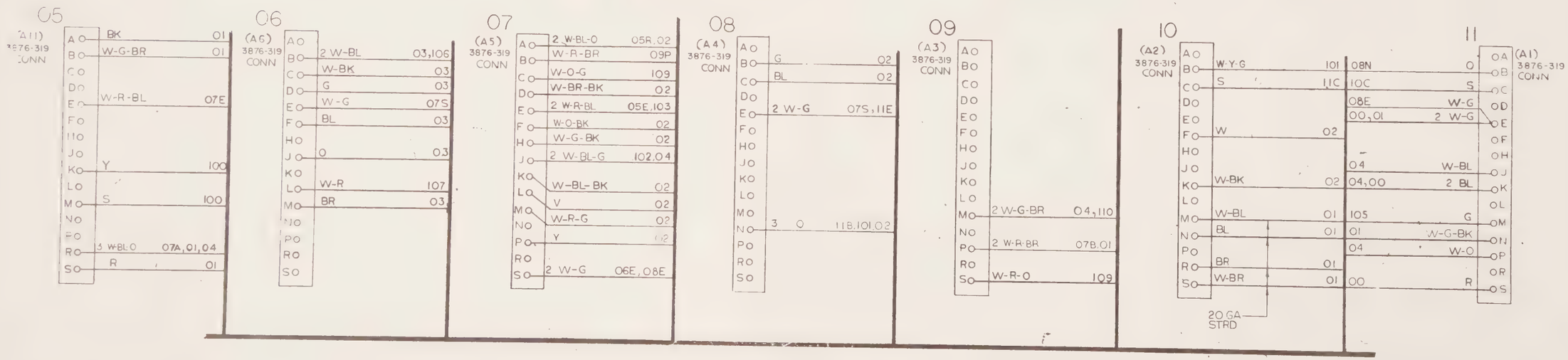
D

SHEET 1 OF 3

FRONT OF MTG CHASSIS



REAR OF MTG CHASSIS



PIGTAIL COMP INFORMATION			
REF. DESIG	L.P.C. PT NO	VALUE	LOCATION

ISSUE 13

WIRING DIAGRAM
CONTROL UNIT
4865-703

T-4865-703

LORAIN PRODUCTS CORPORATION

DWG SIZE D

SHEET 2 OF 2

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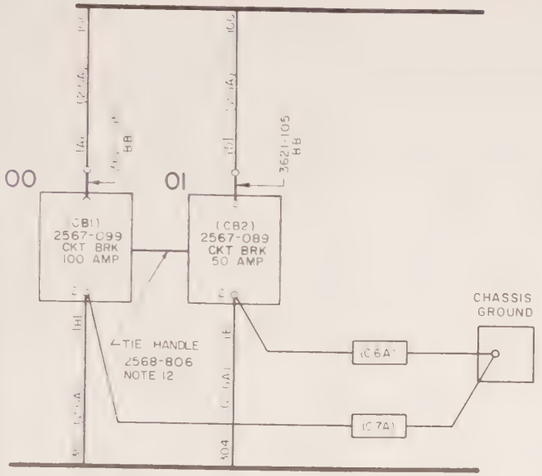
LP433

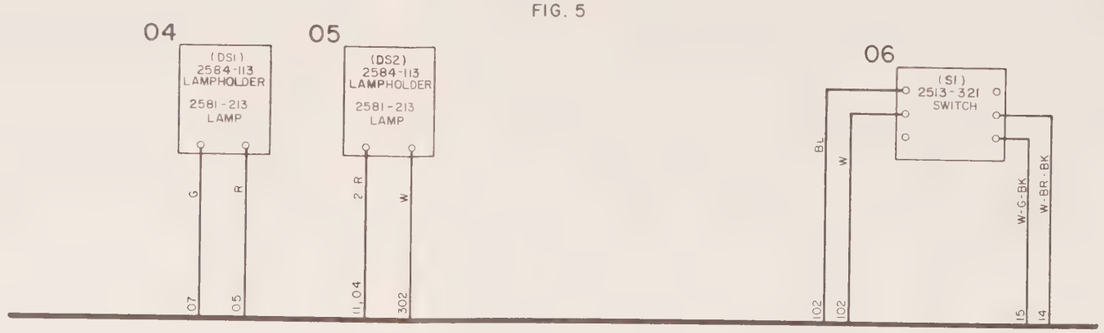
FIG. 4

CKT BKR PANEL (FRONT VIEW FIG. 4 ONLY)



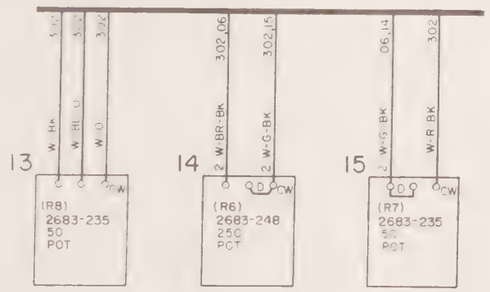
METER PANEL

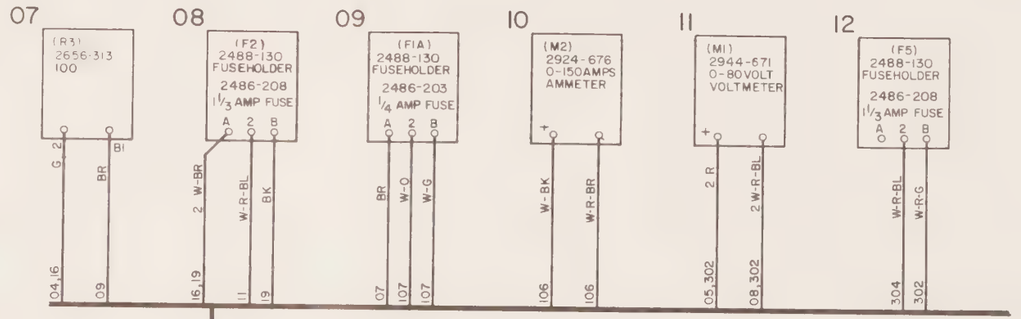
FIG. 5

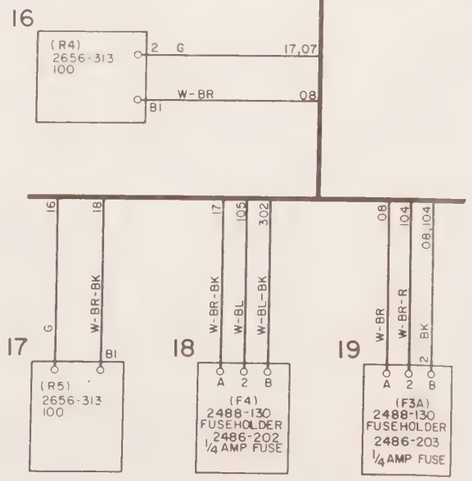


POT. PANEL

FIG. 6







PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO	VALUE	LOC
C6A,7A	2715-284	2	01

WIRING DIAGRAM MODEL M100F50	T-5451-001
LORAIN PRODUCTS CORPORATION D	SHEET 2 OF 3

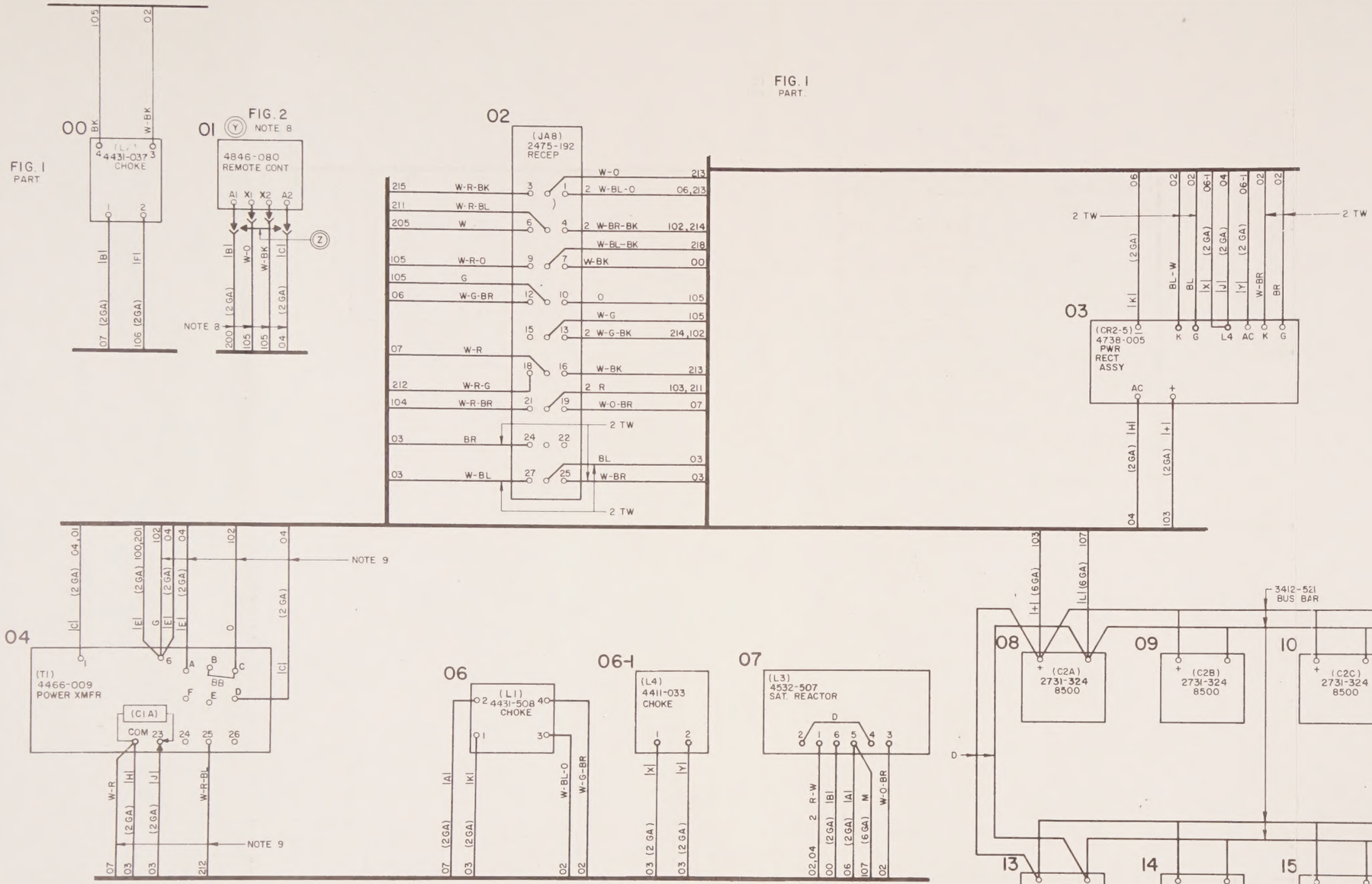


FIG. 1
PART

FIG. 1
PART

PIGTAIL COMPONENT INFORMATION				
REF DESIG	LPC PT NO.		VALUE	LOC
R2	2652-335		1000	12
C1A	2715-262		0.5	04

WIRING DIAGRAM MODEL M100F50	T-5451-001
LORAIN PRODUCTS CORPORATION	SHEET 3 OF 3

Made in U.S.A. by
BEAVERITE
BEAVER FALLS, N.Y.
CB 20789
6 75

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